



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

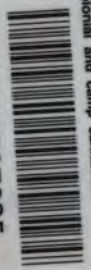
About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

COLONIAL AND CAMP
SANITATION

POORE

LANE MEDICAL LIBRARY STANFORD STOR
1427 .P92 1903
Colonial and camp sanitation.
24503397825



LANE

LANE

GAL



Gift

Gift

Stanford University L

Stanford University



COLONIAL AND CAMP
SANITATION

COLONIAL AND CAMP
SANITATION

By the same Author.

SECOND EDITION. With 13 Illustrations. Crown 8vo. 6s. 6d.

ESSAYS ON RURAL HYGIENE.

LANCET.—'Well worthy of the serious consideration of those into whose hands is committed the control of the public health.'

BRITISH MEDICAL JOURNAL.—'Well worth reading. Dr. Poore attacks the local authority with much spirit, and with unanswerable logic on some points.'

GLASGOW HERALD.—'A highly important book. The whole book is an education in itself. It is a volume to be read and re-read equally by householders and by professional sanitarians. Our only regret is that amid the flood of hygienic literature which is, year by year, turned loose upon the world, there are so few books of this type—fearless, honest, and scientific criticisms of existing errors, and full, likewise, of recommendations whereby these errors may be rectified.'

SECOND THOUSAND. With 86 Illustrations. Crown 8vo. 8s. 6d.

THE DWELLING-HOUSE.

TIMES.—'Dr. Poore does good service in hammering away at the folly of taking town sanitation as a model for more happily situated communities.'

... When it comes to applying model by-laws, intended for large towns, to rural districts, and when rich men build country houses on the base model of the London "mansion," then he is justified in protesting. As a counterblast to the worship of such false gods his book is useful and welcome.'

ENGINEER.—'Lack of space prevents our quoting freely from the section headed "Remedies for Overcrowding," which is admirable, and should be read and re-read by sanitary authorities until they have thoroughly digested it.'

With 13 Illustrations. Crown 8vo. 5s.

THE EARTH IN RELATION TO THE PRESERVATION AND DESTRUCTION OF CONTAGIA:

Being the MILROY LECTURES delivered at the Royal College of Physicians, 1899, together with other Papers on Sanitation.

JOHANNESBURG STAR.—'Dr. Poore has brought his earnest views on the important questions which are involved in modern scientific sanitation, before the general public, in a way which should secure that close attention which such a serious subject demands.'

NATURE.—'The book is a noteworthy one . . . the work of an original thinker and a lucid and polished writer.'

LONGMANS, GREEN, & CO., 39 Paternoster Row, London,
New York and Bombay.

COLONIAL AND CAMP SANITATION

BY

GEORGE VIVIAN POORE, M.D.(LOND.), F.R.C.P.

PROFESSOR OF THE PRINCIPLES AND PRACTICE OF MEDICINE
UNIVERSITY COLLEGE, LONDON
PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL
ETC.

WITH 11 ILLUSTRATIONS

LANE LIBRARY

LONGMANS, GREEN, AND CO.

89 PATERNOSTER ROW, LONDON

NEW YORK AND BOMBAY

1908

MP

All rights reserved

YAGSULI BNAI

I 427
P 82
1903

PREFACE

It has been represented to the author that the publication of a few extracts from his larger works might meet the wants of persons living in remote places in the Colonies or elsewhere, by furnishing them with correct principles of sanitation. The following pages have accordingly been taken from 'The Milroy Lectures' and 'The Dwelling-house,' as containing matter which is applicable to camp and colonial sanitation.

24A PORTLAND PLACE,
LONDON, W.

102057

CONTENTS

CHAPTER I

	PAGES
THE SANITATION OF CAMPS—FLIES AND THE SCIENCE OF SCAVENGING—SALISBURY PLAIN—BURIAL OF FÆCES— TRENCHES—VEGETATION AND CULTIVATION—TEMPORARY CAMPS—KITCHEN REFUSE—FLIES AND THEIR MULTIPLI- CATION—CHEMICAL DISINFECTANTS—NEATNESS . . .	1-12

CHAPTER II

AN EXPERIMENT IN SANITATION—COLLECTION OF RAIN- WATER—DISPOSAL OF SLOP-WATER—COUNTRY COTTAGE —WATER ANALYSIS—STRAINING FOR SLOP-WATER— FILTRATION GUTTER—EARTH CLOSET—DRY CATCH— DRY URINALS—HOUSING OF ANIMALS—CONSTRUCTION OF WELLS	13-39
INDEX	41-48

ILLUSTRATIONS

FIGURE	PAGE
1. VIEW OF COTTAGE	<i>To face</i> 15
2. PLAN OF COTTAGE	15
3. SINK, FILTRATION GUTTER, AND TRENCH (LONGITUDINAL SECTION)	21
4. DUPLICATED TANK FILTER	22
5. FILTRATION GUTTER	23
6. FILTRATION TRENCH (CROSS-SECTION)	23
7. EARTH CLOSET	26
8. EARTH CLOSET (VERTICAL SECTION)	26
9. DRY URINAL (SECTION AND ELEVATION)	30
10. PLAN OF SURFACE WELL	38
11. SECTION OF SURFACE WELL	38

CHAPTER I

THE SANITATION OF CAMPS—FLIES AND THE SCIENCE OF SCAVENGING¹

IN the recent debate² at the Clinical Society of London on Dr. H. H. Tooth's paper³ on enteric fever in South Africa it was established: (1) that the number of flies in our camps was prodigious; and (2) that these flies were largely a result of the military occupation. There seems also to have been a very general consensus of opinion (3) that flies may convey infection. It becomes therefore of great importance to consider the genesis of flies; and I trust that one who has no claims to be considered a dipterologist may be pardoned for recalling a few common facts.

Flies multiply at a prodigious rate. Given a temperature sufficiently high to hatch the eggs, their numbers are only limited by the amount of food available for them. Linnæus is credited with the saying that three meat-flies, by reason of their rapid multiplication, would consume a dead horse quicker than would a lion, and the fact that certain diptera having some outward resemblance to the honey-bee lay their eggs in the dead carcasses of animals probably led Samson and Virgil to

¹ Reprinted from the *Lancet*, May 18, 1901.

² *Ibid.* March 16, p. 786, and 30, 1901, p. 932.

³ *Ibid.* March 16, 1901, p. 769.

make erroneous statements with regard to the genesis of honey and the manufacture of bees. The breeding of 'gentles' for ground-bait is an industry the practisers of which could probably give much information as to the nicety of choice exercised by flies in selecting material for feeding and egg-laying. According to Packard the house-fly makes selection of horse-dung by preference for ovipositing, and as each female lays about 120 eggs and the cycle of changes from egg to fly is completed in less than three weeks it seems probable that a female fly might have some 25,000,000 descendants in the course of a hot summer. Other varieties of flies multiply, I believe, still more rapidly.

As flies multiply upon, and in, organic refuse of every kind it is obvious that the sooner such refuse is placed where it cannot serve for the feeding and hatching of flies the more likely is the plague of flies to be lessened. The most commonly available method for the bestowal of organic refuse is burial. The egg-laying of flies in dead carcasses commences at the very instant of death, or even before death in the case of enfeebled animals. This fact has been insisted upon by M^égnin in 'La Faune des Cadavres,' and appears to be true of human beings dying from fever. It is obvious, therefore, that there must be no delay in the burial of organic refuse, and that the burial of animals and excreta is quite as important as the burial of human beings. After a great battle it may not be possible to follow this advice, but nevertheless there can be no harm in insisting that the instant burial of all organic refuse must be the aim of those who are called upon to guard the public health, whether military or civil.

It is impossible to lay down any line of action which shall be the best in all circumstances, and those

who, like myself, have not been through the South African campaign are incompetent to deal with the special circumstances of that campaign. Nevertheless, I am of opinion that much that I have witnessed on Salisbury Plain in connection with camp-scavenging is bad and is not calculated to teach the soldier the right principles of dealing with organic refuse, which is always his most dangerous enemy. The science of scavenging requires to be taught. If the duty of scavenging be left to the ignorant and be controlled by persons who think that necessary details are beneath their notice, then annoyance and disease are the only results possible.

If the scavengings of a camp are to be satisfactorily dealt with the question of their ultimate disposal must be ever present in the mind of the scavenger. The materials collected have to be burnt, to be buried, or to be otherwise dealt with. The mere dumping of refuse in mixed heaps ought certainly to be abandoned, and the contents of the latrines ought to undergo immediate superficial burial at the nearest available spot in order to avoid cartage and spilling. In many cases it should be possible to bury the excreta in the immediate vicinity of the spot where they are dropped. We hear of excreta being buried in trenches ten feet deep, but such a course must mean that they are left exposed to give off odours and to breed flies for many hours before they are under ground and covered up. I have consulted a gravedigger on this question and asked him, 'If you were ordered to dig a grave ten feet deep what breadth and length would be necessary, and what time would you require?' His reply was that (in chalk) the grave would have to be six and a half feet long and three and a half feet wide, and that he would require a day and a half to

complete the work. It is certain that thirty-six or forty-eight hours' delay in the disposal of fæces is most undesirable. I have always advocated the burial of fæces in shallow furrows rather than in deep trenches, and, in this country at least, where alone I have had experience, I am convinced that this is the only reasonable course to pursue. If properly done all offence to eyes or nose is thus ended and the fæces cease to attract either flies or rats. The fæces can be covered continuously as soon as they are dropped, and there is no need of having malodorous open trenches partially filled which are waiting to be completely filled before being covered up.

This burial of fæces must be done methodically and carefully and with every attention to detail. The proceedings must be precisely those of a gardener who is intent upon raising crops. The fact that in war the crops may never be harvested is quite beside the mark and affords no excuse for slovenly procedures which are a danger to health. Nitrification in the soil is the aim equally of the sanitarian and the agriculturist. If a plot of ground fifty yards long and fifty yards wide—slightly more than half an acre—be allotted for the disposal of fæces this should be marked off into, say, sixteen strips, each about eight feet wide and fifty yards long, with a narrow path of about eighteen inches between each strip to allow for watering and cultivation. The line of the furrows must be accurately marked by a cord and reel in the ordinary way, and the digger must move continuously backwards in order to avoid trampling on the freshly dug ground. The making of the furrows should commence at the point furthest from the latrines and it should gradually come nearer to them. The earth removed from the first furrow

should be wheeled down near the latrines, where it will be ultimately wanted to cover the last furrow which is dug. The capacity of the furrow or little trench will depend upon the size of the spade. I find that, working in ordinary garden soil with a spade having a blade nine inches long and seven inches wide (the furrow being consequently nine inches deep and seven inches wide), eight stable-bucketfuls of soil each holding two and a half gallons, or about twenty-two pounds weight of earth, were removed. This amounts to two and a half bushels of soil, weighing 176 pounds, as the measure of the capacity of a trenchlet eight feet long. This trench must be filled with excreta, and great care must be taken that nothing except *fæces* and paper and the accompanying urine is placed in it. If broken crockery or old tins are accidentally mixed with the excreta they must be removed. The trench being filled with *fæces*, mark out a digging line at a distance equal to the width of the spade (seven inches) behind the edge of the first trench and then cover the *fæces* in the first trench by the earth removed in making the second. Owing to the draining away of urine and moisture and their great compressibility it will be found that the excreta undergo a considerable diminution of bulk when tipped into the trench. When the earth of the second trench has been removed and shovelled on to the top of the first trench it will be found that there is a raising of the general level of the ground, and the second trench will be found to have a cross section which is rather triangular than rectangular, owing to the oblique direction of its front wall, which is composed of a sloping bank of friable earth. The surface of the ground must be left crumbly, smooth, and perfectly neat, like a well-prepared garden bed. No particle of *fæces* or paper

must be left uncovered. There will be no offence to eye or nose, no putrefaction is possible, and the fæces are beyond the reach of dipterous insects, and if there has been no delay in the collection and burial of the fæces they cannot have been used for oviposition to any great extent, so that the soil will not become infested with 'grubs.'

How many men will provide the quantity of fæces which can be placed in a trench eight feet long from which 176 pounds weight of earth have been removed? The answer to this question is governed by bulk rather than by weight. If fæces and earth were equal in bulk for equal weights and if we allow a quarter of a pound of fæces for each man—for the urine soaks away and *qua* bulk may be neglected—then the answer would be $176 \times 4 = 704$. If the fæces are weight for weight four times as bulky as the earth, the answer is 176. In any case it seems safe to say that a trench eight feet long, nine inches deep, and seven inches wide will suffice to take the fæces of 100 men. This estimate entirely accords with my experience gained in my garden at Andover, where the fæcal accumulations of twenty cottages have been disposed of daily in the manner indicated for eighteen years, and where it takes at least five years to cover an acre of ground in this way. Those who have not had experience of this method of dealing with fæces are apt to have exaggerated views as to the amount of land required. If a trench eight feet long and seven inches wide is sufficient for the disposal of the daily quota of excreta from 100 men, then ten such trenches occupying an area of eight feet by seventy inches—say six feet—is enough for 1,000 men, and one strip of ground fifty yards long and eight feet wide would serve for a regiment of 1,000 men for twenty-five

days, and the sixteen strips would serve for 400 days—let us say half an acre per annum per 1,000 men. The actual area necessary will depend to some extent upon the nature of the soil and the care and skill of the scavenger, but in no case can the area required be regarded as a bar to the process—certainly not on the Veld or on Salisbury Plain. It need not be insisted on that a scavenger must be incessantly at work. The excreta should be taken up as soon as dropped and be placed in a covered pail, and the pail when full should be emptied into the furrow and covered up. In this way effluvia are stopped and ovipositing by diptera is rendered impossible. Further, this method of disposing of faeces necessitates no increase of the impedimenta of an army; no lime or chemicals are needed, and no apparatus beyond a spade and a set of garden tools.

The ground beneath which the faeces are deposited should when the work is done have the appearance of a well-prepared garden bed and it will need little attention until it is covered with herbage of some kind. The only question remaining to be decided is as to what that herbage should be. There can be no camp without water-supply, and in every camp one of the sanitary problems is the disposal of waste water. Some of this waste water should be used in time of drought for laying dust and encouraging fertility in that small area of ground beneath the well-tilled surface of which the faeces are safely bestowed. Then, the higher the temperature the quicker will the ground bring forth green leaves to freshen the air. Whether the crop be grass, cabbage, cereals, onions, mustard and cress, lettuces, spinach, or what not must depend upon circumstances. I think the seeds sown in such ground should always be those of culinary vegetables, which

may prove a real blessing if the camp be long occupied. With a little care in a hot climate one may have a green covering of grass or mustard and cress in a week, which at least will give off oxygen to the air even if it do not serve as an antiscorbutic diet for man and beast—a diet which may just supply that something which is lacking in tinned and salted provisions.

In a temporary camp these methods of excrement disposal are the best on the grounds of immediate hygiene. In places like Salisbury Plain, which are to be used as camping-grounds year after year, latrine gardens are essential, and, if properly managed, should furnish a good many acceptable extras for the canteens. In 1900 at Perham, on Salisbury Plain, there was a field of many acres occupied by the scavenging contractor and placed a few hundred yards from the camping-ground. On this were piled heaps of camp refuse, old tins, meat bones, broken victuals, packing materials, and faeces which had been 'dumped' with a view to burning when dry enough. In their recent state these heaps (in which flies were swarming) could be smelt for a quarter of a mile down wind, and when they began to burn the offensive smoke drifted still further and not seldom over the camps themselves. This haphazard method of 'dumping' refuse in pestiferous heaps is not economical, not even from the point of view of the area of ground required, and would be rendered unnecessary by a little care in collection and the judicious use of the spade by men who knew how to turn these despised materials to profitable account. Horsedung in the same way should be neatly stacked in heaps like hotbeds, protected at the sides and covered with earth. In this way the flies would be prevented

from feeding and egg-laying on the dung, large quantities of saladings might be produced, and when the camp was moved this well-rotted material should be applied to the camping-ground with a view to the renovation of the turf. On Salisbury Plain the growth of summer is trodden under foot and there is no systematic renovation in the winter. On turf downs the actual camping-ground should be changed every year and the ground 'top dressed' as soon as the camp breaks up in the autumn. Without careful management and good husbandry these downs will soon be trampled and scuffled into a dusty wilderness. In the same way all the kitchen refuse should (after utilisation to a maximum extent in the stock-pot, &c.) be neatly stacked, protected at the sides, and covered with earth. All organic refuse should be completely protected by soil from the attacks of diptera, and its fertilising properties should be utilised forthwith.

It is sometimes said that we ought to be ready to forgive the house-flies for the annoyance which they cause to us because of their great services as scavengers; but I am rather inclined to take the view that the presence of flies is a reproach to us for not putting organic refuse to its proper use, and that the fly is a robber which has been bred in material which we have deliberately allowed to lie above ground instead of covering it with soil. The scrupulous sweeping up of crumbs and food particles immediately after meals and the instant removal of the remains of food to fly-proof larders need not be insisted upon. I believe that a great advance in domestic hygiene will have been made when the custom is more general of removing dung every day from our stables, piggeries, cattle-sheds, and poultry-runs, and stacking it carefully so as to

prevent the access of diptera, or burying it immediately beneath the surface of well-tilled soil with a view to the production of crops. We pity the horse 'turned out' in a paddock when we see it tormented with 'flies.' Few of us pause to think that if the horsedung had been collected daily and put to more profitable use instead of being allowed to lie about and generate a plague of flies the animal might have been happier and the dung might have been more valuable for fertilising purposes. When flies breed in dung-heaps the larvæ eat the dung and leave the straw. If each fly needs one grain only of sustenance then the 25,000,000 which I have stated as the possible season's progeny of a female house-fly will be capable of robbing a farmer of 25,000,000 grains of fertilising material, which at 7,000 grains to the pound works out at 3,571 pounds, or considerably more than one and a half tons. It is bad economy to have your scavenging done by flies and sad to see your potential wealth make to itself wings and fly away. In my garden at Andover where human excreta have undergone daily superficial burial for about eighteen years there is no excess of flies, and I have come to the conclusion that an essential part of garden management is the daily collection of all garden offal, such as dead leaves, fallen and rotten fruit, &c., and either superficially burying or stacking it so that it shall not serve as a breeding-ground for insects which often prey upon the plums and peaches in the autumn.

In the management of refuse I am no advocate for the use of chemical disinfectants. These are expensive, generally evil-smelling, often poisonous, and lead to an increase of material to be transported. The soil is quite capable, with proper management, of turning all organic refuse into 'soil'—a fact which the experiments of Sir

Seymour Haden and myself have abundantly proved. Our experiments have also shown that from the point of view of the innocuous transformation of organic refuse into 'soil' deep burial is a mistake. This is true alike of dead animals and of excreta. We are happily hearing less of the pollution of the earth and of the growth of microbes and toxins in the soil, and even from the laboratories of bacteriologists we are learning that the soil is our best friend. The use of quicklime in the treatment of excreta is, I believe, quite unnecessary. My experiments in burying small animals tend to show that the quicklime preserves the body and mischievously prevents the beneficent action of the soil. In the management of refuse, there must be no slovenly 'dumping.' What is wanted is proper sorting at the time of collection, great attention to detail, absolute neatness, and an appreciation of the ends to be attained.

In recommending the immediate collection of all organic refuse and its instant covering with earth, I am making no new recommendation. Moses had had experience of a 'plague of flies' in Africa and was no novice in the matter of camp-management. He found it necessary to be most explicit in his directions for the treatment of excreta. These directions are given in Deuteronomy xxiii. 12-14, and I find that in the Revised Version of the English Bible there is an interesting change in the passage. The old version runs thus :

'Thou shalt have a place also without the camp, whither thou shalt go forth abroad :

'And thou shalt have a paddle upon thy weapon ; and it shall be, when thou wilt ease thyself [sittest down] abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee :

'For the Lord thy God walketh in the midst of thy

camp, to deliver thee, and to give up thine enemies before thee; therefore shall thy camp be holy: that he see no unclean thing in thee [nakedness of anything], and turn away from thee.'

The new version says (verse 13): 'Thou shalt have a paddle *among* thy weapons,' and as a variant for paddle gives 'shovel' in the margin. The passage, therefore, means that a shovel for burying excreta immediately is a necessary implement in every camp.

CHAPTER II

AN EXPERIMENT IN SANITATION—COLLECTION OF
RAIN-WATER—DISPOSAL OF SLOP-WATER¹

THIS cottage is represented (*see* fig. 1) not because of any architectural beauty, but because it presents points of interest. It forms the lodge of Gallagher's Copse, which is a mile from Andover Junction, just outside the borough boundary. The borough having recently adopted the Model By-laws of the Local Government Board, it became necessary to trek over the border in order to escape from possible hindrances and prohibitions—an important matter, because the owner is, in the matter of house-building, an experimentalist. The soil is chalk. The foundations were laid out by the aid of a compass, in order to ensure that one angle of the cottage should point due north. This arrangement ensures that there is a possibility of some sunshine upon every wall of the house at every season of the year. The accommodation consists (*see* fig. 2) of a living-room (L), three bedrooms (B, B, B), scullery and wash-house (S), glazed verandah (V, V), earth closet (C), wood-house (W), and rain-water tank (T).

In the house it will be noticed that there is a door front and back, so that the passage can be swept by a thorough draught; that no room communicates directly

¹ Reprinted from *Country Life* of July 6, 1901.

with any other room ; and that every room has a fire-place, which, from the point of view of ventilation, is most important. No fireplace is placed against an outside wall. The chimneys do not get chilled, and 'draw' admirably.

This cottage contains what ought to be the minimum accommodation, viz. a living-room, and a bedroom each for parents, boys, and girls. The scullery and wash-house is so placed that, although it can be reached under cover, the smell of cooking and the steam of washing need not invade the dwelling-house. The earth closet is well removed from the rooms, but, nevertheless, can be reached under cover, *via* verandah and wash-house. The walls are built of 'mud,' with rough-cast on the outside. Mud (*i.e.* chalk puddled up with a certain proportion of straw), flints, and timber are the only building materials found in the district. Most of the clay-pits in the immediate vicinity have been long worked out, and there is no stone. Mud is a non-conductor of heat, and is consequently a very warm material. It is said in the district that frozen water-pipes are very uncommon in mud houses. It is very lasting, provided it be kept dry. Mud walling should be begun in March, and should not be carried on after the beginning of September. It is not advisable to hurry your operations. Foundations are necessary for mud walls, and these should be of flint, concrete, brick, or stone. The mud is 15 inches thick, and with rough-cast on the outside and a lining of match-boarding the thickness of the walls is about 17 inches, and the fireplaces being all in the centre and every side exposed to the sun, it is needless to say that the cottage has proved a very snug winter residence. The floors are of concrete, finished in granite cement, and the skirtings are of the same material.



FIG. 1.—VIEW OF COTTAGE.

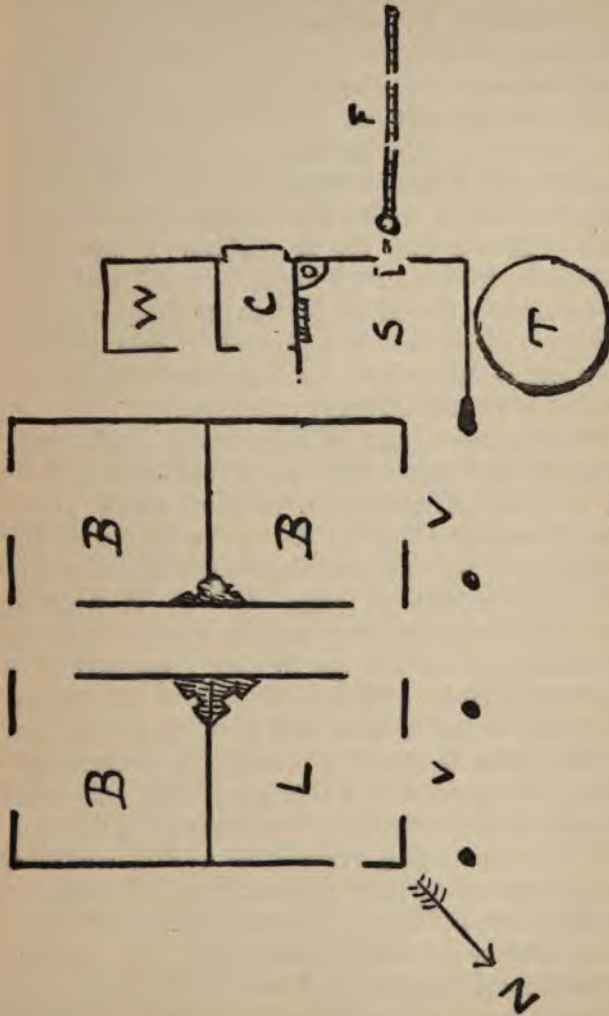


FIG. 2.

Plan of Cottage: L, living-room. B B B, bedrooms. S, scullery. O, earth-closet. W, wood-house. V V, verandah. T, rain-water tank. F, stop filter and filtration guttier.

Mud walls are inexpensive. The price paid for the walls of the above cottage was 5s. per perch, *i.e.* a piece of wall 1 foot high, 15 inches thick, and $16\frac{1}{2}$ feet long.

The Model By-Laws of the Local Government Board say that the walls of a dwelling-house must be of hard and incombustible material bonded together with good mortar or cement. Now as mud is not hard, contains straw, and is not bonded with anything, it is doubtfully by-legal in districts which have adopted these Model By-laws. In the late fire at Andover it was found that while the thatched roofs blazed, the old mud walls of the cottages withstood the fury of the flames. When the tendency of by-laws is to boycott a local building material and to extinguish a local industry, the *pros* and *cons* ought to be very carefully considered.

An interesting feature of this cottage is the rain-water tank. Although I have a deep well close at hand which supplies an abundance of pure water, I was anxious to ascertain how far rain-water falling on the roof was capable of being utilised for household purposes, notwithstanding that in some districts of England cottages which are dependent upon rain-water only are not permitted. With this end in view, I was careful to provide a very plain, simple roof, without recesses for the lodgment of dirt or nests, and it was this which led me to use slates as a roofing material in preference to the more picturesque tiles which grow moss. My rain-water tank is constructed on the principle of the Venetian cistern. In a city which reached the highest pinnacles of commercial and artistic supremacy on 'rain-water,' one is tolerably sure to get valuable ideas for the collection and storage of that commodity. The Venetian cistern is of large capacity, and is so arranged that all water drawn from the central well has previously passed

through a sand filter. The tank is circular in form, having an internal diameter of 7 feet and a depth of 10 feet. It is divided down the centre by a diaphragm, which is perforated at the bottom by three agricultural drain pipes. Each half of the tank contains 3 feet of filtering material consisting of (from above, down) 1 foot of coarse gravel, 1 foot of fine gravel, and 1 foot of sand. The rain-water which falls from the roof passes through two strainers contained in an ornamental vase, and then, before being pumped, passes down through 1 foot of coarse gravel, 1 foot of fine gravel, and 1 foot of sand, and up through a similar filter, before it can be drawn from the pump. The tank is constructed entirely of cement concrete, and the pump has a copper suction pipe. It was important to avoid the use of lead, iron, or galvanised iron for the storage of rain-water intended for dietetic purposes. It will be noticed that all the water has to be raised by a pump, so that none of it can accidentally run to waste. The drips from the pump are conducted back into the unfiltered half, and should a boy play with the pump, he will merely ensure a double filtration for the water, and will not be able to waste any of it. I believe that half the water which we are supposed to 'use' is merely wasted by carelessness and bad taps. It will be noted that the water tank has been brought to the front of the house, and that an ornamental vase has been used for conducting the water from the roof. Anything amiss with the water tank will be noticed at once. This seems better than a dirty water-butt in an obscure corner. Those who have more money and taste will, I hope, soon outdo me in this direction. I commend the rain-water tank to the attention of architects.

It may be well to dwell for a moment on the powers of this roof as a rain collector. The area of the roof is

(approximately) 1,100 square feet, and if the annual rainfall fluctuate between 24 inches and 30 inches, then the amount of rain falling upon the roof will vary from 2,200 cubic feet to 2,750 cubic feet. If we take a cubic foot as the equivalent of $6\frac{1}{4}$ gallons, then we may say that the amount of rain annually falling on the roof will fluctuate between 13,750 gallons and 17,187 gallons. If we put the average water-supply of the roof at 15,000 gallons a year, or rather more than forty gallons a day, we shall not be far wrong.

Water experts say that in towns we want a supply of forty gallons per head per diem. The dweller in the clean country is content with much less than this, and I feel convinced that ten gallons a day is an extravagant estimate for the daily supply of a perfectly clean peasant who does clothes-washing at home, but has not the power of wasting water.

The storage capacity of the tank is about 1,600 gallons, or forty gallons a day for a drought of six weeks. The water is excellent, odourless and colourless, and altogether very unlike ordinary rain-water.

The water of this cistern was analysed both chemically and bacterioscopically for the Royal Commission on Sewage Disposal on November 14, 1901, and with the following results :

Parts per 100,000 by weight.	
Ammoniacal nitrogen	0.064
Albuminoid "	0.020
Nitrite	0.033
Nitrate	0.086
Oxygen absorbed from permanganate	{ at once . 0.23
at 80° F.	
After incubation at 80° F. for 6 days	{ at once . 0.23
Combined chlorine	0.16
Dissolved oxygen (parts per 1,000 by volume)	2.8

'Sample clear but yellow, no sediment, peculiar faint smell rather like soot.'

The above is a typical analysis of rain-water. To the eye and palate it is the best sample of rain-water I have ever seen, and it has been used for all domestic purposes. It should be said that the yellow colour is very slight. Personally I cannot detect any smell, but there is a faint taste of terra-cotta.

Dr. Houston found 25 bacteria per c.c. on gelatine at 20° C., and 7 per c.c. on agar at 37° C. The tests for *Bacillus coli* and *Bacillus enteritidis sporogenes* gave negative results.

These analyses are full of instruction, and show how chemistry and bacteriology are needed to check each other, and how both need to be checked by a knowledge of source and circumstances.

The disposal of slop-water is always an important consideration in cottage management. Usually this means slop-water plus roof-water, but in this cottage the roof water has been provided for. The amount of slops, allowance being made for evaporation in cooking, and washing and drinking, must always be considerably less than the water consumed. Economy in the use of water lessens the slop difficulty.

In this instance the slops are strained and filtered, and allowed to flow away in a 'filtration gutter,' to be presently described. The arrangements are on the south side of the cottage, well exposed to the sun, so as to favour evaporation.

The sink is just beneath the window of the scullery, and the waste-pipe, without trap of any kind, passes through the wall, and terminates in a free end about 18 inches from the wall and 2 feet 6 inches above the

level of the ground. The waste-pipe empties itself into a strainer and filter, which are placed about 15 inches from the cottage wall, so as to avoid the risk of splash or back soakings or accumulations of 'dirt' and insects between the wall and the filter. The strainer is placed on the top of the filter, and the filter discharges its water on to a filtration gutter. This filter is shown in fig. 1 at the extreme right, and is marked with a cross. A longitudinal section of the arrangement is shown in fig. 3.

The strainer consists of a basket with a wisp of straw in it (B). This arrests all but the finest particles, and is the best fat-trap I know—the only one, in fact, which does its work efficiently and without offence. The straw may be changed as often as necessary—every day, once a week, once a month, according to the amount of accumulations, which will largely depend upon the thriftiness and knowledge of the cook. The contents of the strainer may be given to the chickens, put on the manure heap, or burnt. A new handful of straw is then put in and the strainer replaced. The changing of the straw has the advantage of giving a new direction to the water. Any old basket of suitable size which will hold the straw answers the purpose of a strainer. After months of use it will get greasy and rotten, and may then be burnt and be replaced by a new one. From the strainer the slops flow into the filter, which is simply a galvanised iron vessel, with an outlet at the bottom and filled with broken clinker varying in size from peas at the bottom to walnuts at the top. This filter effects a further purification of the slops, and acts partly mechanically and partly by virtue of the growth of bacteria, on the surface of the broken clinker. The filter shown has been specially constructed, and is duplicated (*see* fig. 4), and the waste-

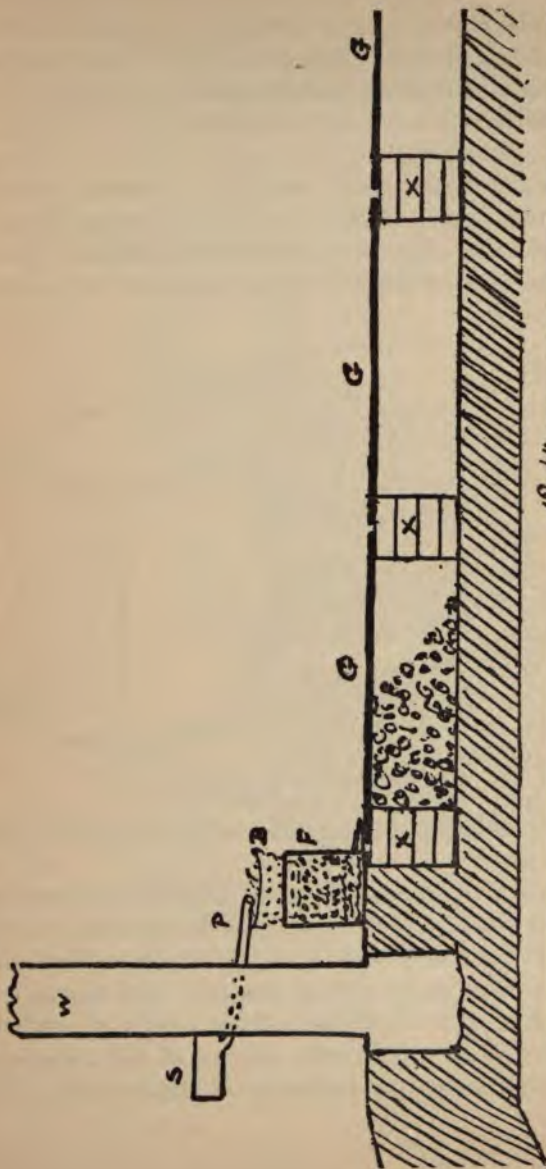


Fig. 3.

S, sink. W, wall of cottage. P, waste-pipe. B, basket containing straw. F, filter. G, cast-iron filtration gutter, supported in trench by (X) columns of bricks on edge.

pipe of the sink is provided with a reversible nozzle so that either half of the filter can be used. For a cottage, however, this is not necessary, and an old galvanised iron bucket with a hole in the bottom will be found to answer every purpose.

The filtration gutter consists of strong cast-iron guttering, perforated with conical holes, having the small ends upwards so that they cannot get jammed (*see fig. 5*). This guttering, which is 9 inches wide and in lengths of

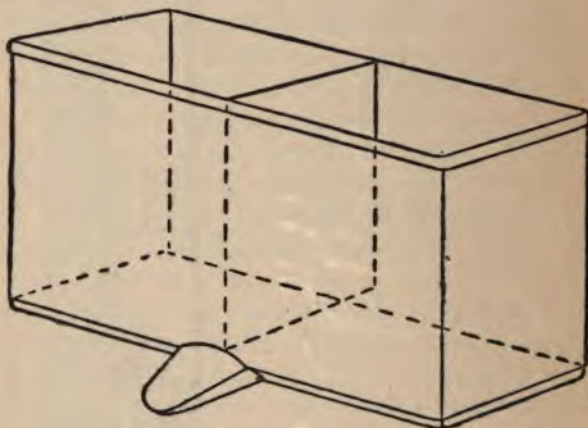


FIG. 4.—DUPLICATED TANK FILTER.

6 feet, is laid upon loose porous rubble or gravel placed in a trench.

A trench 18 inches wide and 18 inches deep was first dug from the filter due south, care being taken that the bottom of the trench should slope away from the cottage, in order that water should not flow back towards the foundations of the building. The lengths of guttering are then laid on a level with the top of the trench, the level being maintained by means of bricks on edge, built

up without mortar in little columns of four from the bottom of the trench, each column, except the first and last, serving to support the ends of adjacent lengths of



FIG. 5.—FILTRATION GUTTER.

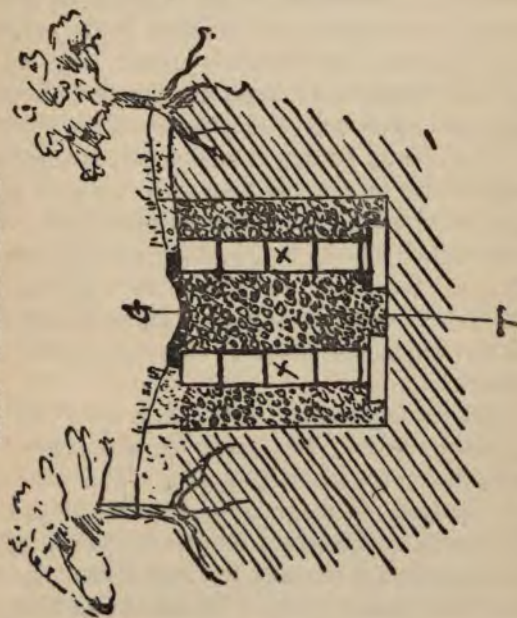


FIG. 6.

G, east-iron filtration gutter supported on bricks on edge (X).
T, trench 18" x 18" filled with coarse rubble.

guttering. It being ascertained that the level of the guttering is true, with the slightest possible slope downward from the filter, the trench is finally filled with loose rubble of any kind—builders' rubbish, burnt clay, lumps of chalk, gravel, clinker, coke, whatever may be most readily obtained. This arrangement is shown in longitudinal section (fig. 3) and in cross section (fig. 6). Care should be taken that the packing be accurately done at the junctions of the lengths of guttering, in order to give support and firmness to the brick supports. When finished, the filtration gutter looks as though it had been simply laid upon the ground, there being, of course, no indication of the rubble-filled trench beneath it. The iron guttering is sufficiently strong to permit a wheelbarrow or cart to pass over it, and there is no objection to taking the gutter across a path. The sides of the trench should be planted; or the trench may be dug in a shrubbery or plantation. At the cottage in Gallagher's Copse the trench is taken across the garden, and the sides are planted with raspberries and black currants.

The arrangement shown has been in use since September 1900. The straw in the basket has been changed about once a fortnight. The filter has never been changed; we have never seen the slops run further than the end of the first length of guttering, and when the slops are not running the gutter and its neighbourhood looks perfectly dry. There is absolutely no smell, no offence to eye or nose. The length of gutter provided is 24 feet (four lengths), but the water has never been seen to travel more than 6 feet.

Next, as to expense. The guttering has been made for me by Messrs. Tasker, of the Waterloo Iron Works, Andover, and costs 1s. 6d. per foot run, and the special

duplicated slop filter was supplied by the same firm at a cost of 27s. 6d. The total cost, therefore, of draining this cottage was as under :

	£	s.	d.
Labour for digging trench, &c.	0	2	6
Basket	0	0	9
Filter	1	7	6
Four lengths of filtration gutter (24 feet in all)	1	16	0
Forty-eight old bricks, clinkers, &c., say	0	1	0
	£3 7 9		

But if an old basket and an old galvanised pail be employed, and if two lengths of guttering be used instead of four, then the above bill will be reduced by 2l. 6s. 3d., leaving 1l. 1s. 6d. as the total cost for providing drainage for the cottage. Not only does the filtration gutter allow the slop-water to flow away, but it stops back dead leaves, which otherwise would soon choke the porous rubble in the trench.

I may say that I advise that nothing but open guttering be used for slop-water, be it perforated or otherwise. Wherever this putrescible mixture flows in the dark, the faint smell of drains is soon perceptible. Where all is open, those little accidents which proverbially will happen are seen at once.

Finally, the construction of the earth closet demands a few words. Its precise situation and the reasons for it have been previously alluded to. The closet is lighted by a skylight, and air is freely admitted everywhere, both in the closet and beneath the seat—a point of very great importance. The receptacle is capacious, and is in the form of a 'dry catch,' as described in 'Rural Hygiene' and 'The Dwelling-house.' The seat is only 14 inches high. The earth is contained in a bin fed

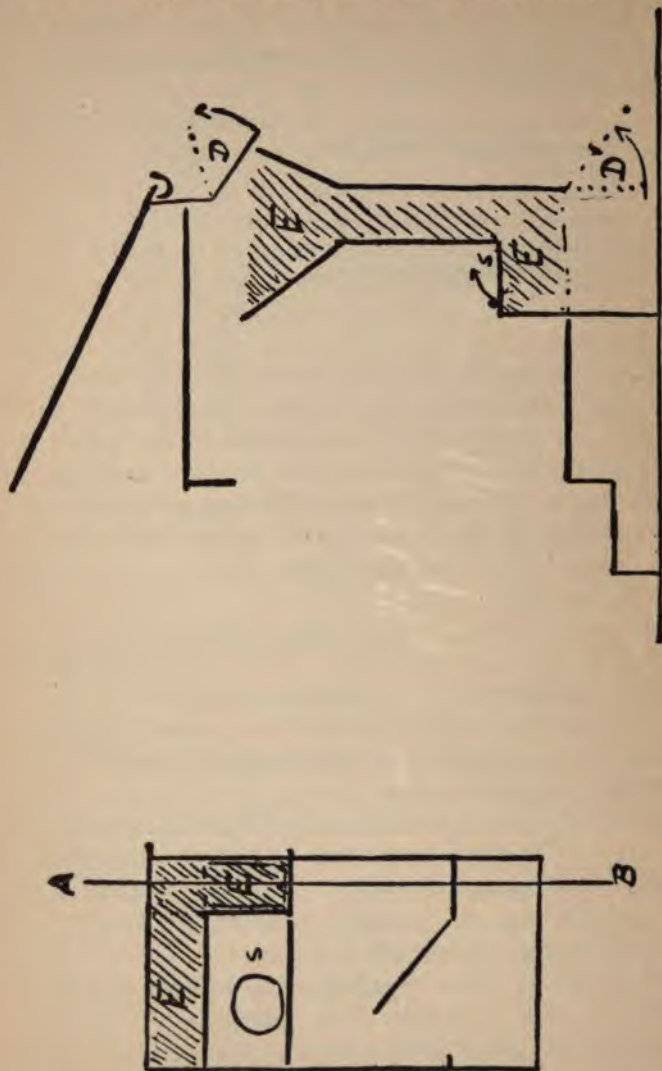


FIG. 7.

Earth Closet.—Fig. 7, plan.

FIG. 8.

Fig. 8, vertical section through A-B. E, earth bin and hopper, S, seat, D, door for filling hopper, D', door for removing soil.

from a large hopper-reservoir, which holds enough earth for about 1,000 uses of the closet. The earth is added by means of a hand scoop. The earth box is filled, and the soil is removed, from the outside. In the illustration (fig. 1) the lid of the hopper, through which the earth is supplied, is plainly visible. Figs. 7 and 8 show a plan and a vertical section.

The following are the main principles to be observed in the construction and management of earth closets.

1. The earth should be stored in a bin, and be thrown on the excreta with a scoop. A disused packing-case placed alongside the seat will serve every purpose.

2. The excreta may be received in a bucket or allowed to fall into a 'dry catch.' They should be removed every day if possible.

3. There must be free ventilation beneath the seat, so that it may be possible for effluvia to escape elsewhere than into the closet. The absence of such ventilation is one of the common defects in earth closets. The provision of such ventilation causes draughts. For delicate persons a shutter must be provided to be closed when necessary.

4. The bucket or excreta should be removed from behind, the opening being closed by a wire guard (about as stiff as a fire-guard) to prevent the access of dogs or vermin.

5. The larger the amount of earth which can be stored in the bin the better. The constant need of replenishing the earth-bin is a great and serious drawback. The amount of earth remaining in the bin should be always visible, so that its replenishment may be provided for. It is quite easy to provide a bin which will hold a ton of earth.

6. The bucket must be cleaned by emptying, scraping,

and finally dusting with dry earth ; and a little earth should be thrown in before it is replaced. It must not be washed or whitewashed.

7. An earth closet attached to a house should be highly finished and be well lighted and ventilated, and should be so constructed that the bin may be filled and the excreta removed from the outside.

8. A seat supported at either end by an old packing-case in which earth may be stored is an excellent makeshift.

9. This may be covered by a rough shed or tent.

10. No antiseptics should be used. They poison the earth and destroy its manurial value.

DRY URINALS

Earth, sand, peat, sawdust, or any other dry and absorbent material exercises a purifying influence on urine which is allowed to filter slowly through it,¹ and there are circumstances when such urinals may be very useful.

They are admirably suited for use on race-courses, cricket and football grounds, and other places where people congregate occasionally. On my advice they have been placed on two cricket grounds near London, and have given great satisfaction ; they have been used also in the engineers' yard attached to the Twickenham Station of the London and South Western Railway, which is visited by a large number of men (averaging perhaps 150) every day, and the South-Western Railway have fitted them up at one of their country stations.

Again, in country houses a urinal for gentlemen placed in some accessible but secluded spot, and formed

¹ See 'The Dwelling-house,' pp. 49 *et seq.*

of a basket or barrel of convenient height filled with peat or sawdust, will be found both economical and inoffensive. In the garden of a little cottage I have such a urinal, consisting of a small barrel filled with peat, which has been in use for nearly eighteen months, and which has never been changed, and is yet perfectly free from offensive odour. It is only when the top layers are removed that the nose perceives an ammoniacal odour, and then only when placed almost in contact with the peat.

I am accustomed to advise that such urinals for public use should be in the form of troughs made of basket-work or hurdling, or of wood panelled with perforated zinc, the trough to be triangular in section, with apex downwards, 3 feet 6 inches wide at the upper part, and 2 feet 4 inches in depth.

The shape of the trough and the material of which it is made facilitate evaporation. Such a trough should be under cover to prevent the access of rain, and it is obvious that with a width of 3 feet 6 inches it might be used from either side, provided a match-board screen were placed vertically along the centre (see fig. 9).

Allowing 2 feet of length for every 'place,' it follows, there being a 'place' on either side, that each foot of length would afford one place.

It might be necessary to allow the wicker-work trough to have an open gutter beneath it, but it is only exceptionally that any effluent would be afforded.

If such a trough is in constant use the sawdust must be turned over and stirred occasionally, and if this be done it will never be foul, and the sawdust can be used for surprisingly long periods of time without emptying.

If sufficient sawdust, or peat, or dry earth be pro-

vided for a double charge, so that one charge may be drying in a shed while the other is in use, my belief is that this might be used for indefinite periods.

A final question, and one of very great importance, is the ultimate destination of the absorbent material.

Sawdust has a very bad reputation with agriculturists, who assert that when used in large quantities it grows fungi and poisons the land. If fresh sawdust be used, and if it be employed in relatively large quantities,

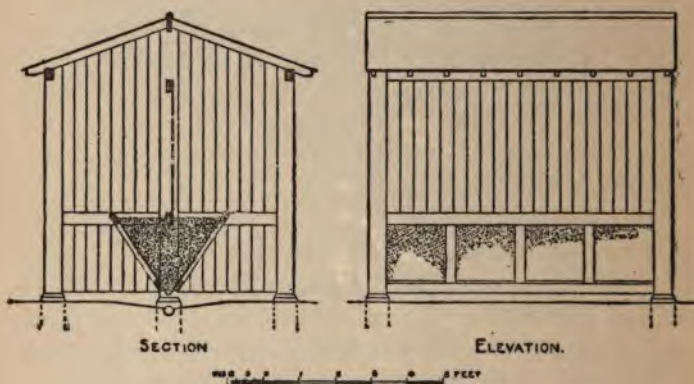


FIG. 9.—DRY URINAL.

and especially if it be buried too deeply, I can well understand that it would prove prejudicial to crops.

I can positively assert, however, that deal sawdust or peat, after being soaked with urine, shows no disposition whatever to become mouldy. I have never seen mould upon deal sawdust, but I have seen it upon oak sawdust.

My experiments further show that when sawdust or peat has been used as a top-dressing good crops have followed, whether on grass or garden ground. The

cricket clubs which have, in accordance with my advice, put up dry catch closets and dry urinals have used the products as a top-dressing at the end of the season, and with the result that their wicket pitches have been the envy of their neighbours. The dressing must be thin or the sawdust or peat should be passed through a riddle and diluted with soil before application. If too thickly applied it will 'burn' the grass like pure guano.

Chemists tell us that urine is of high manurial value because of the large amount of nitrogen which it contains. This is doubtless true, but we all know that the immediate effect of pure urine is fatal to herbage. Whether this be due to the heat of the fresh urine or the salts I do not know, but I fancy the latter. In the same way we know that a sprinkling of salt, or salt and water, kills weeds; but we are told that salt is a bad weed killer, because it ultimately acts as a manure, and causes increased growth. Now urine does the same thing.

The farmer who uses the urine and dung of his animals mixed with absorbent material (generally straw), and ultimately places it on the land as a top-dressing, gets nothing but good from it.

The practices I advocate are exactly analogous to those which have been used by agriculturists in every age, and with the best results. I am merely advocating a return to customs which have been tried again and again and have never been found wanting.

In the 'Journal of the Royal Agricultural Society' (vol. vii., part iv., December 1896) I find a statement (p. 631) that in the delta of the Nile a compost of earth and cattle urine is generally used as a manure.

'Owing to the lack of wood, the people are compelled, as in India, to use the solid droppings of their cattle as

fuel, but they conserve the urine on a very ingenious system. Loose earth, shifted and renewed from time to time, is used as a covering for the stable floor, and earth is so much in demand for this purpose that the irrigation officers can hardly prevent the people from carrying away the canal banks.' Analyses show from 1.25 to 2.5 per cent. in equivalent of nitrate of soda. It is obvious, however, that a chemical analysis gives but a poor idea of the value of the compost. It is applied at the rate of eight tons to the acre for growing sugar and maize.

HOUSING OF ANIMALS

In country places and in connection with country houses provision has to be made for the proper housing of animals.

Speaking broadly, there can be no doubt that the more fresh air we give our animals (the more they are in the open and the less they are under cover) the better.

Sheep are rarely housed, unless it be with a view to their getting prizes for being in a condition of diseased obesity.

On Mr. Stephens's farm at Cholderton one may see not only sheep, but herds of cattle and numerous brood mares and foals, all in the rudest health, notwithstanding that they never go within doors from year's end to year's end.

It is the same with poultry. If they are to be kept healthy they must be confined indoors as little as possible. 'Who,' says Cobbett, 'can get up as early as the birds?' and it must be remembered that birds are out nearly an hour before sunrise all the year round. If poultry be locked up, with a view to forcing egg-

production by keeping them warm, it is probable that they will become tuberculous.

Sir Frederick Fitzwygram, in his exhaustive treatise on the Horse, is very careful to insist on the perfect ventilation of stables, and tells us of certain London cab stables where the health of the horses became excellent after the doors and windows were removed.

In the construction of stables Sir Frederick Fitzwygram insists on the danger of underground drains, and advises that the drainage of a stable shall be by open gutters only, and that these gutters shall lead to gullies removed many yards from the stable door. This is rational common sense, and must be applied not only to stables, but to human habitations also.

Trapped gullies are only miniature cesspools, and the presence of such contrivances within stables or cow-houses means that the animals are breathing the gases of putrefaction whenever they are within doors.

It is a question whether in such places we do not often go to a huge expense in order to do things wrongly.

I call to mind three cow-houses which I visited in the autumn of 1895. One was at a very old-fashioned manor-house near Alresford, Hants, and was a high-pitched, thatched, barn-like building, which had been used for cows 'time out of mind.' There was an open door at either end; the floor of the stalls was of beaten earth, and the middle passage between the stalls was of flint pitching. The stalls had a very slight slope from head to tail, and there was no drain of any kind, and no water-tap for the adulteration of the milk or the 'swilling down' of the building. The dung was removed every morning with shovel and besom, and, if necessary, some earth was thrown upon the floor of the stalls. This house was fragrant, and filled with the

sweet breath of kine and the aroma of good upland hay. There was no suggestion or suspicion of foulness. The urine in this case must have soaked away to a great extent into the earth and between the pitching, and had done so in this place, perhaps, for centuries.

The other two cow-houses were of a different order. One was at an establishment devoted to giving technical instruction in dairying, and the other belonged to a milkman in a country town. Both had cost much money, with impermeable bricked floors, water-taps for swilling down, and drains within the building for carrying away the valuable dung and urine. They were both damp, with water lying between and in the grooves of the bricks, and both had a sickening smell of putrefaction. Neither of these last two cow-houses was desirable place in which to collect milk. I have little doubt that the *Bacterium coli*, which lives in water, was very abundant in both of them.

Water (unless it be boiling hot and used with abundance of soap and a scrubbing-brush) is entirely out of place in cow-houses, dairies, and butchers' shops.

Putrefaction is easily attained by swilling with cold water. Real cleanliness is unattainable in this way.

The dung and urine of all domestic animals is invaluable for the farm and garden, and it all ought to be carefully preserved. I feel that the best way of doing so would be to allow the stalls of stables, cow-houses, piggeries, &c., to have a very gentle slope to a gutter or trough filled with absorbent material, such as earth or peat moss, and protected by a grating. This trough would be cleaned out whenever it became in the least offensive, and thus the whole of the urine would be saved for the farm.

It needs hardly to be said that all animal houses

must be kept scrupulously clean. There must be no accumulations of dung, and all such ordure must be removed daily. The besom and shovel and wheelbarrow are the only proper tools for doing this.

If 'water-carried sewage' be introduced on the farm the ruin of the farmer is more certain than it is at present.

CONSTRUCTION OF WELLS

It is admitted that humus is one of the best filtering materials for water, and that water from a river full of living organisms is to a large extent freed from them by filtering through a few feet of the humus on its banks. In the past few years Sir E. Frankland demonstrated that water of singular microbial purity could be obtained from the gravel beds which in places flank the Thames. Such water, one must suppose, is obtained from ground water which has fallen upon the earth, has filtered through it, and is slowly flowing towards the river. The purifying agent in these cases is mainly the living humus which lies upon the surface, although the subsoil cannot be without some effect. These facts must alter our attitude towards surface wells, and must teach us what to a great extent has been admitted—that the purity of surface wells must depend more upon the mode of construction and the surroundings of the well than upon its depth. Wells are polluted by foulness which has reached the subsoil without being subjected to the purifying influence of the humus; and there are many facts which go to show that if foul water gets to the under side of the humus without going through it its purification in the subsoil is far from certain. The Lausen epidemic, the Worthing epidemic, and the pollution of the deep well sunk in the sandstone at Liverpool,

seem to show us that percolation through a mile of underground strata entails no certain purification, and that wells 80 ft. or 400 ft. deep are not safe if fissures allow the contents of cesspools, leaking under pressure, to trickle into them. The almost universal condemnation of surface wells and their frequent pollution are mainly due to the fact that we take our filthy and dangerous liquids through the humus in pipes, and thus ensure at great expense that they cannot be subjected to purification by it. If these underground pipes leak, the mischief caused by pollution of wells may be very far-reaching. It is very probable that foul water continuously thrown on the same spot of ground may in time work its way to a well and thus pollute it. Such ground, which is constantly soaked, be it remembered, is never tilled, because tillage is impossible. For ground to be tillable it is essential that reasonable breathing-time should be allowed. I am not altogether sure (although I hardly dare utter such a heresy) that a properly constructed surface well in a selected situation may not prove to be one of the safest sources for water, because it can be inspected with perfect ease, and the fact of accidental leakage into it would become apparent. In this connection it may be well to describe in full detail the well which I have sunk in my garden at Andover, a garden which is rather handsomely manured with human excreta. The well is placed in the very centre of the garden (see fig. 10) at the intersection of two paths—a broad green path and a narrow asphalted path. This situation was chosen for two reasons: (1) that it was as far as possible removed from any accidental pollution from the sewer in the street; and (2) that in the centre of the garden it would theoretically run the greatest chance of faecal contamination from the manure

used. As the well was sunk solely for experimental purposes this was essential. The garden is on a river-bank and very slightly raised above the level of the water. The well is only some 5 ft. deep, and the water stands at a level (which varies very slightly) of about 3 ft. 6 in. from the bottom. The well is lined throughout from the very bottom to a point some 15 in. above the ground with large concrete sewer-pipes 2 ft. 3 in. in diameter, and these pipes have been carefully cemented at their junctions. Outside the pipes a circle of cement concrete about 4 in. thick has been run in. It will thus be evident, the sides being perfectly protected, that no water can possibly enter this well except through the bottom, all contamination by lateral soakage through the walls being rendered impossible. The well is surrounded by an asphalted path about 3 ft. wide and slightly sloping away from it, and it is encircled by a clipped privet hedge about 5 ft. high, except at those points where the circle of privet is cut by the paths. There is a closely fitting cover of oak, which has an outer casing of lead, and thus all contamination from above is prevented. The water is drawn off through a 2-in. leaden pipe which passes through the outer concrete and the concrete lining pipe, the cut passage for the pipe being carefully closed with cement. The pump is behind the privet hedge, and is provided with a sink and waste pipe which takes the overflow some twenty or thirty yards to a neighbouring stream. In this way the constant dripping of water in the neighbourhood of the well is prevented; for I am very much alive to the dangers attending a constant water-drip, which might be able in time to worm its way through soil and concrete into the well itself. I regard this question of the overflow as one of great importance which is too often neglected. Figs. 10 and 11 show this

well in section and plan. The nearest point to the well upon which any manurial deposit of excreta is likely to be made is on the far side of the privet hedge, and the distance of this point from the bottom of the well is 7 ft.

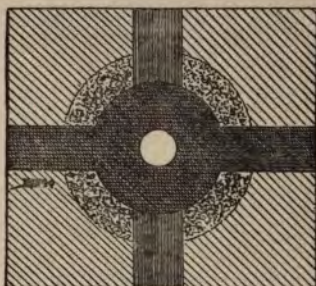


FIG. 10.—PLAN OF WELL,
SHOWING ITS RELATION TO PATHS AND HEDGE.

All water which finds its way into the well must have passed through at least 6 ft. or 7 ft. of earth, and, of course, the great bulk of the water has passed through a far greater length. Three chemical analyses of this



FIG. 11.—SECTION OF WELL,
SHOWING CONCRETE LINING AND POSITION OF PUMP.

water, one by Professor Frankland and two by Dr. Kenwood, testify to its organic purity, and three bacteriological investigations have given similar indications of purity. A bacteriological examination of the water from the river Anton and the well water,

made on April 11, 1895, gave 1,133 growths per cubic centimetre for the river and only 7·5 for the well. Of course there may be a dangerous microbe among this small number, but, on the whole, I think the best guarantee of the purity of the water is the condition of the well, which after four years is as clean on the bottom and sides as it was the day it was made. There has been no appreciable increase of sediment on the bottom, and the pebbles are as plainly visible as they ever were. The well is for experimental purposes mainly, but water for garden use is drawn from it, and during the severe frost of 1895-6 my gardener and some of his neighbours were entirely dependent upon it for household purposes. I seldom go into my garden without drinking some of the water, which is clear and delicious, and my visitors seldom escape without drinking some also. I think the well is a very safe one.

N.B.—Since the above was written I have sealed this well, because I found that in spite of all I could do a large number of insects (woodlice, spiders, &c.) got beneath the lid and fouled the water standing in the well.

1

2

3

4

5

6

7

INDEX

- ALRESFORD**, cow-houses at, 33
Analyses of water, 19, 35, 38
Andover garden experience, 6, 10
— surface well, 36, 37, 38
Animals, housing of, 32
Antiseptics, 28
Anton, river, 38
- BUILDING of cottage**, 13
Burial of organic refuse, 2
By-laws, Model, of Local Government Board, 13, 16
- CAB-STABLES**, 33
Camp scavenging on Salisbury Plain, 3
Camps, sanitation of, 1, 3
Cholderton, Mr. Stephens's farm at, 32
Cistern, Venetian, 16
Cleanliness, 9, 35
Cobbett and birds, 32
Cottage at Gallagher's Copse, 13, 15
Cow-houses, 33, 34
— model, so-called, 34
- DRAINAGE of cow-houses**, 33; of stables, 33
- Dry catch in earth-closet**, 25, 27
Dry urinals, 28
Dumping of refuse, 8, 11
Dung removal, 9, 33
- EARTH-CLOSET**, 14, 25, 26, 27
Enteric fever, 1, 35
Epidemics, enteric fever, 35
Excreta, burial of, 5, 10, 11, 12; Moses on, 11
Experiment in sanitation, 13
- FÆCES**, disposal of, 4, 6
Fat-trap strainer, best, 20
Fauna of death, 2
Filter, duplicated tank, 22; for slop water, 20
Filtering water, 17
Filtration gutter, 19, 22, 23, 24
Fireplaces, 14
Fitzwygram, Sir Frederick, on the horse, 33
Flies and the science of scavenging, 1
— conveyance of infection by, 1
— genesis of, 1, 2
— robbing the farmer, 10
Frankland, Sir E., and water analyses, 35, 38
Furrows, 4, 5

- GARDEN offal, 10
Gravedigging, 3
- HADEN'S, SIR SEYMOUR, experiments, 11
Horse-dung, 8
Horses, 33
House-fly, Packard on, 2
Housing of animals, 32
Houston, Dr., bacteriological examination, 19
Humus, 35
- KENWOOD'S, DR, water analysis, 38
Kitchen refuse, 9
- LATRINES in camps, 3, 4, 5
Lausen epidemic, 35
Linnaeus on multiplication of meat-fly, 1
Liverpool epidemic, 35
Local Government Board's Model By-laws, 13, 16
- MANURE, 31, 34
Mégnin on the fauna of death, 2
Moses and plague of flies, 11
— on the burial of excreta, 11
Mud for building, 14
- NILE compost, 31
Nitrification, 4
- ORGANIC refuse, 2
- PACKARD on house-fly, 2
Percolation of water, 36
Perham camp, scavenging at, 8
- Piggeries, 34
Pollution of wells, 35
Poultry, 32
Pump, 17
Putrefaction and water, 34
- QUICKLIME, use of, deprecated, 11
- RATS, 4
Refuse, management of, 10
Roofs, material for, 16
- SALISBURY PLAIN, camp-scavenging on, 3, 8
Samson on honey-bee, 1
Sanitation, experiment in, 13; of camps, 1
Scavenging and flies, 1
— contractor, 8
— of camps, 3
Scullery sink, 19
Sewage, water-carried, 35
Sinks, 19
Slop-water, 19, 25
Soil, 11
Stables, 33
Stephens's, Mr., farm at Cholderton, 32
Strainer, 33
Surface wells, 35
- TANK, rain-water, 16, 18
Thames, 35
Tillage, 36
Tooth, Dr. H. H., on enteric fever in South Africa, 1
Trenches, 4, 5, 6
Turf, renovation of camp, 9
- URINAL, dry, 28, 29, 30
Urine, 5, 31

- VEGETABLE-GROWING in camps, 7
Vegetation, 7
Veld, scavenging on the, 7
Venetian cistern, 16
Virgil on honey-bee, 1
- WATER, analysis of, 18, 35, 38
— and putrefaction, 34
- Water-carried sewage, 35
— collection of rain, 16
— experts, 18
— filtering, 17
— tank, 16, 17
— waste of, 17
Wells, construction of, 35
— surface, 35, 36
Worthing enteric fever epidemic,
35

A SELECT LIST OF BOOKS
IN
NATURAL AND PHYSICAL SCIENCE
MATHEMATICS AND TECHNOLOGY

PUBLISHED BY

MESSRS. LONGMANS, GREEN, & CO.

LONDON: 39 PATERNOSTER ROW, E.C.

NEW YORK: 91 & 93 FIFTH AVENUE.

BOMBAY: 32 HORNBY ROAD.

	PAGE		PAGE
<i>ADVANCED SCIENCE MANUALS</i>	- 38	MEDICINE AND SURGERY	- 25
ALGEBRA - - - -	- 9	MENSURATION - - - -	- 8
AGRICULTURE - - - -	- 35	METALLURGY - - - -	- 19
ARCHITECTURE - - - -	- 14	MINERALOGY - - - -	- 19
ASTRONOMY - - - -	- 20	MINING - - - -	- 19
BACTERIOLOGY - - - -	- 33	NATURAL HISTORY AND GENERAL	
BIOLOGY - - - -	- 32	SCIENCE - - - -	- 23
BOTANY - - - -	- 34	NAVAL ARCHITECTURE - - - -	- 19
BUILDING CONSTRUCTION - - - -	- 14	NAVIGATION - - - -	- 20
CALCULUS - - - -	- 10	OPTICS - - - -	- 12
CHEMISTRY - - - -	- 2	PHOTOGRAPHY - - - -	- 12
CONIC SECTIONS - - - -	- 9	PHYSICS - - - -	- 5
DYNAMICS - - - -	- 6	PHYSIOGRAPHY - - - -	- 22
ELECTRICITY - - - -	- 15	PHYSIOLOGY - - - -	- 32
<i>ELEMENTARY SCIENCE MANUALS</i>	- 38	<i>PRACTICAL ELEMENTARY SCIENCE</i>	
ENGINEERING - - - -	- 17	<i>SERIES</i> - - - -	- 40
EUCLID - - - -	- 10	<i>PROCTOR'S (R. A.) WORKS</i> - - - -	- 21
GARDENING - - - -	- 35	SOUND - - - -	- 13
GEOLOGY - - - -	- 22	STATICS - - - -	- 6
GEOMETRY - - - -	- 10	STEAM, OIL, AND GAS ENGINES - - - -	- 13
HEALTH AND HYGIENE - - - -	- 24	STRENGTH OF MATERIALS - - - -	- 17
HEAT - - - -	- 13	SURVEYING - - - -	- 8
HYDROSTATICS - - - -	- 6	TECHNOLOGY - - - -	- 23
LIGHT - - - -	- 13	TELEGRAPHY - - - -	- 16
LOGARITHMS - - - -	- 10	TELEPHONE - - - -	- 16
<i>LONDON SCIENCE CLASS-BOOKS</i>	- 40	<i>TEXT-BOOKS OF SCIENCE</i> - - - -	- 37
<i>LONGMANS' CIVIL ENGINEERING</i>		THERMODYNAMICS - - - -	- 13
<i>SERIES</i> - - - -	- 18	TRIGONOMETRY - - - -	- 12
MACHINE DRAWING AND DESIGN - - - -	- 18	<i>TYNDALL'S (JOHN) WORKS</i> - - - -	- 36
MAGNETISM - - - -	- 15	VETERINARY MEDICINE, ETC. - - - -	- 31
MANUFACTURES - - - -	- 23	WORKSHOP APPLIANCES - - - -	- 19
<i>MECHANICS</i> - - - -	- 6	ZOOLOGY - - - -	- 32

CHEMISTRY.

ARRHENIUS.—A TEXT-BOOK OF ELECTROCHEMISTRY. By SVANTE ARRHENIUS, Professor at the University of Stockholm. Translated from the German Edition by JOHN MCCRAE, Ph.D. With 58 Illustrations. 8vo., 9s. 6d. net.

CROOKES.—SELECT METHODS IN CHEMICAL ANALYSIS, chiefly Inorganic. By Sir WILLIAM CROOKES, F.R.S., etc. Third Edition, Rewritten and Enlarged. With 67 Woodcuts. 8vo., 21s. net.

FURNEAUX.—ELEMENTARY CHEMISTRY, Inorganic and Organic. By W. FURNEAUX, F.R.G.S., Lecturer on Chemistry, London School Board. With 65 Illustrations and 155 Experiments. Crown 8vo., 2s. 6d.

GARRETT AND HARDEN.—AN ELEMENTARY COURSE OF PRACTICAL ORGANIC CHEMISTRY. By F. C. GARRETT, M.Sc. (Vict. et Dunelm.), Assistant Lecturer and Demonstrator in Chemistry, the Durham College of Science, Newcastle-on-Tyne; and ARTHUR HARDEN, M.Sc. (Vict.), Ph.D., Assistant Lecturer and Demonstrator in Chemistry, the Owens College, Manchester. With 14 Illustrations. Crown 8vo., 2s.

JAGO.—Works by W. JAGO, F.C.S., F.I.C.

INORGANIC CHEMISTRY, THEORETICAL AND PRACTICAL. With an Introduction to the Principles of Chemical Analysis, Inorganic and Organic. With 63 Woodcuts and numerous Questions and Exercises. Fcp. 8vo., 2s. 6d.

AN INTRODUCTION TO PRACTICAL INORGANIC CHEMISTRY. Crown 8vo., 1s. 6d.

INORGANIC CHEMISTRY, THEORETICAL AND PRACTICAL. A Manual for Students in Advanced Classes of the Science and Art Department. With Plate of Spectra and 78 Woodcuts. Crown 8vo., 4s. 6d.

KLÖCKER.—FERMENTATION ORGANISMS: a Laboratory Handbook. By ALB. KLÖCKER. Translated by G. E. ALLAN, B.Sc., and J. H. MILLAR, F.I.C. With 146 Illustrations in the text. 8vo., 12s. net.

MELLOR.—HIGHER MATHEMATICS FOR STUDENTS OF CHEMISTRY AND PHYSICS. With Special Reference to Practical Work. By J. W. MELLOR, D.Sc., late Senior Scholar, and 1851 Exhibition Scholar, New Zealand University; Research Fellow, the Owens College, Manchester. With 142 Diagrams. 8vo., 12s. 6d. net.

MENDELÉEFF.—THE PRINCIPLES OF CHEMISTRY. By D. MENDELÉEFF. Translated from the Russian (Sixth Edition) by GEORGE KAMENSKY, A.R.S.M., of the Imperial Mint, St. Petersburg; and Edited by T. A. LAWSON, B.Sc., Ph.D., Fellow of the Institute of Chemistry. With 96 Diagrams and Illustrations. 2 vols. 8vo., 36s.

MEYER.—OUTLINES OF THEORETICAL CHEMISTRY. By LOTHAR MEYER, Professor of Chemistry in the University of Tübingen. Translated by Professors P. PHILLIPS BEDSON, D.Sc., and W. CARLETON WILLIAMS, B.Sc. 8vo., 9s.

CHEMISTRY—Continued.

MILLER.—INTRODUCTION TO THE STUDY OF INORGANIC CHEMISTRY. By W. ALLEN MILLER, M.D., LL.D. With 71 Illustrations. Fcp. 8vo., 3s. 6d.

MUIR.—A COURSE OF PRACTICAL CHEMISTRY. By M. M. P. MUIR, M.A., Fellow and Prælector in Chemistry of Gonville and Caius College, Cambridge. (3 Parts.)

Part I. Elementary. Crown 8vo., 4s. 6d.

Part II. Intermediate. Crown 8vo., 4s. 6d.

Part III. [In preparation.]

NEWTN.—Works by G. S. NEWTH, F.I.C., F.C.S., Demonstrator in the Royal College of Science, London.

CHEMICAL LECTURE EXPERIMENTS. With 230 Illustrations. Crown 8vo., 6s.

CHEMICAL ANALYSIS, QUANTITATIVE AND QUALITATIVE. With 100 Illustrations. Crown 8vo., 6s. 6d.

A TEXT-BOOK OF INORGANIC CHEMISTRY. With 155 Illustrations. Crown 8vo., 6s. 6d.

ELEMENTARY PRACTICAL CHEMISTRY. With 108 Illustrations and 254 Experiments. Crown 8vo., 2s. 6d.

PERKIN.—QUALITATIVE CHEMICAL ANALYSIS (ORGANIC AND INORGANIC). By F. MOLLWO PERKIN, Ph.D., Head of the Chemistry Department, Borough Polytechnic Institute, London. With 9 Illustrations and Spectrum Plate. 8vo., 3s. 6d.

PLIMMER.—THE CHEMICAL CHANGES AND PRODUCTS RESULTING FROM FERMENTATIONS. By R. H. ADERS PLIMMER. 8vo., 6s. net.

REYNOLDS.—EXPERIMENTAL CHEMISTRY FOR JUNIOR STUDENTS. By J. EMERSON REYNOLDS, M.D., F.R.S., Professor of Chemistry, University of Dublin. Fcp. 8vo., with numerous Woodcuts.

Part I. Introductory. Fcp. 8vo., 1s. 6d.

Part II. Non-Metals, with an Appendix on Systematic Testing for Acids. Fcp. 8vo., 2s. 6d.

Part III. Metals, and Allied Bodies. Fcp. 8vo., 3s. 6d.

Part IV. Carbon Compounds. Fcp. 8vo., 4s.

SHENSTONE.—Works by W. A. SHENSTONE, F.R.S., Lecturer on Chemistry in Clifton College.

THE METHODS OF GLASS-BLOWING AND OF WORKING SILICA IN THE OXY-GAS FLAME. For the Use of Physical and Chemical Students. With 43 Illustrations. Crown 8vo., 2s. 6d.

A PRACTICAL INTRODUCTION TO CHEMISTRY. Intended to give a Practical acquaintance with the Elementary Facts and Principles of Chemistry. With 25 Illustrations. Crown 8vo., 2s.

CHEMISTRY—Continued.

SMITH AND HALL.—THE TEACHING OF CHEMISTRY AND PHYSICS IN THE SECONDARY SCHOOL. By ALEXANDER SMITH, B.Sc., Ph.D., Associate Professor of Chemistry in the University of Chicago, and EDWIN H. HALL, Ph.D., Professor of Physics in Harvard University. With 21 Woodcuts, Bibliographies, and Index. Crown 8vo., 6s. net.

THORNTON AND PEARSON.—NOTES ON VOLUMETRIC ANALYSIS. By ARTHUR THORNTON, M.A., and MARCHANT PEARSON, B.A., Assistant Science Master, Bradford Grammar School. Medium 8vo., 2s.

THORPE.—Works by T. E. THORPE, C.B., D.Sc. (Vict.), Ph.D., F.R.S., Principal of the Government Laboratory, London. Assisted by Eminent Contributors.

A DICTIONARY OF APPLIED CHEMISTRY. 3 vols. 8vo. Vols. I. and II., 42s. each. Vol. III., 63s.

QUANTITATIVE CHEMICAL ANALYSIS. With 88 Woodcuts. Fcp. 8vo., 4s. 6d.

THORPE AND MUIR.—QUALITATIVE CHEMICAL ANALYSIS AND LABORATORY PRACTICE. By T. E. THORPE, C.B., Ph.D., D.Sc., F.R.S., and M. M. PATTISON MUIR, M.A. With Plate of Spectra and 57 Illustrations. Fcp. 8vo., 3s. 6d.

TILDEN.—Works by WILLIAM A. TILDEN, D.Sc. London, F.R.S., Professor of Chemistry in the Royal College of Science, South Kensington.

A SHORT HISTORY OF THE PROGRESS OF SCIENTIFIC CHEMISTRY IN OUR OWN TIMES. Crown 8vo., 5s. net.

INTRODUCTION TO THE STUDY OF CHEMICAL PHILOSOPHY. The Principles of Theoretical and Systematic Chemistry. With 5 Illustrations. Fcp. 8vo., 5s. With ANSWERS to Problems. Fcp. 8vo., 5s. 6d.

PRACTICAL CHEMISTRY. The principles of Qualitative Analysis. Fcp. 8vo., 1s. 6d.

WATTS' DICTIONARY OF CHEMISTRY. Revised and entirely Rewritten by H. FORSTER MORLEY, M.A., D.Sc., Fellow of, and lately Assistant Professor of Chemistry in, University College, London; and M. M. PATTISON MUIR, M.A., F.R.S.E., Fellow, and Praelector in Chemistry, of Gonville and Caius College, Cambridge. Assisted by Eminent Contributors. 4 vols. 8vo., £5 net.

WHITELEY.—Works by R. LLOYD WHITELEY, F.I.C., Principal of the Municipal Science School, West Bromwich.

CHEMICAL CALCULATIONS. With Explanatory Notes, Problems and Answers, specially adapted for use in Colleges and Science Schools. With a Preface by Professor F. CLOWES, D.Sc. (Lond.), F.I.C. Crown 8vo., 2s.

ORGANIC CHEMISTRY: the Fatty Compounds. With 45 Illustrations. Crown 8vo., 3s. 6d.

PHYSICS, ETC.

BIDGOOD.—ELEMENTARY PHYSICS AND CHEMISTRY FOR THE USE OF SCHOOLS. (In Three Books.) By JOHN BIDGOOD, B.Sc., Headmaster of the Gateshead School of Science.

Book I. Elementary Physics. With 120 Illustrations. Crown 8vo., 1s. 6d.

Book II. Physics and Chemistry. With 122 Illustrations. Crown 8vo., 1s. 6d.

BOSE.—RESPONSE IN THE LIVING AND NON-LIVING.

By JAGADIS CHUNDER BOSE, M.A. (Cantab.), D.Sc. (Lond.), Professor, Presidency College, Calcutta. With 117 Illustrations. 8vo., 10s. 6d.

* * This volume describes experimental investigations on animal, vegetable and inorganic substances regarding their response to stimulus. These researches show that the effects of fatigue, stimulants, depressants and poisons are alike in the organic and inorganic, and demonstrate that the response phenomena in the 'living' have been foreshadowed in the 'non-living'.

GANOT.—Works by PROFESSOR GANOT. Translated and Edited by E. ATKINSON, Ph.D., F.C.S., and A. W. REINOLD, M.A., F.R.S.

ELEMENTARY TREATISE ON PHYSICS, Experimental and Applied. With 9 Coloured Plates and Maps, and 1048 Woodcuts, and Appendix of Problems and Examples with Answers. Crown 8vo., 15s.

NATURAL PHILOSOPHY FOR GENERAL READERS AND YOUNG PEOPLE. With 7 Plates, 632 Woodcuts, and an Appendix of Questions. Crown 8vo., 7s. 6d.

GLAZEBROOK AND SHAW.—PRACTICAL PHYSICS. By

R. T. GLAZEBROOK, M.A., F.R.S., and W. N. SHAW, M.A. With 134 Illustrations. Fcp. 8vo., 7s. 6d.

GUTHRIE.—MOLECULAR PHYSICS AND SOUND. By

F. GUTHRIE, Ph.D. With 91 Diagrams. Fcp. 8vo., 1s. 6d.

HELMHOLTZ.—POPULAR LECTURES ON SCIENTIFIC

SUBJECTS. By HERMANN VON HELMHOLTZ. Translated by E. ATKINSON, Ph.D., F.C.S., formerly Professor of Experimental Science, Staff College. With 68 Illustrations. 2 vols., crown 8vo., 3s. 6d. each.

HENDERSON.—ELEMENTARY PHYSICS. By JOHN

HENDERSON, D.Sc. (Edin.), A.I.E.E., Physics Department, Borough Road Polytechnic. Crown 8vo., 2s. 6d.

MACLEAN.—EXERCISES IN NATURAL PHILOSOPHY.

By MAGNUS MACLEAN, D.Sc., Professor of Electrical Engineering at the Glasgow and West of Scotland Technical College. Crown 8vo., 4s. 6d.

MEYER.—THE KINETIC THEORY OF GASES. Elemen-

tary Treatise, with Mathematical Appendices. By Dr. OSKAR EMIL MEYER, Professor of Physics at the University of Breslau. Second Revised Edition. Translated by ROBERT E. BAYNES, M.A., Student of Christ Church, Oxford, and Dr. Lee's Reader in Physics. 8vo., 15s. net.

VAN 'T HOFF.—THE ARRANGEMENT OF ATOMS IN

SPACE. By J. H. VAN 'T HOFF. Second, Revised, and Enlarged Edition. With a Preface by JOHANNES WISLICENUS, Professor of Chemistry at the University of Leipzig; and an Appendix 'Stereo-chemistry among Inorganic Substances,' by ALFRED WERNER, Professor of Chemistry at the University of Zürich. Translated and Edited by ARNOLD EILOART. Crown 8vo., 6s. 6d.

PHYSICS, ETC.—Continued.

WATSON.—Works by W. WATSON, A.R.C.S., F.R.S., D.Sc., Assistant Professor of Physics at the Royal College of Science, London.

ELEMENTARY PRACTICAL PHYSICS: a Laboratory Manual for Use in Organised Science Schools. With 120 Illustrations and 193 Exercises. Crown 8vo., 2s. 6d.

A TEXT-BOOK OF PHYSICS. With 568 Diagrams and Illustrations, and a Collection of Examples and Questions with Answers. Large crown 8vo., 10s. 6d.

WORTHINGTON.—A FIRST COURSE OF PHYSICAL LABORATORY PRACTICE. Containing 264 Experiments. By A. M. WORTHINGTON, M.A., F.R.S. With Illustrations. Crown 8vo., 4s. 6d.

WRIGHT.—ELEMENTARY PHYSICS. By MARK R. WRIGHT, M.A., Professor of Normal Education, Durham College of Science. With 242 Illustrations. Crown 8vo., 2s. 6d.

MECHANICS, DYNAMICS, STATICS, HYDRO-STATICS, ETC.

BALL.—A CLASS-BOOK OF MECHANICS. By Sir R. S. BALL, LL.D. 89 Diagrams. Fcp. 8vo., 1s. 6d.

GOODEVE.—Works by T. M. GOODEVE, M.A., formerly Professor of Mechanics at the Normal School of Science, and the Royal School of Mines.

THE ELEMENTS OF MECHANISM. With 357 Illustrations. Crown 8vo., 6s.

PRINCIPLES OF MECHANICS. With 253 Illustrations and numerous Examples. Crown 8vo., 6s.

A MANUAL OF MECHANICS: an Elementary Text-Book for Students of Applied Mechanics. With 138 Illustrations and Diagrams, and 188 Examples taken from the Science Department Examination Papers, with Answers. Fcp. 8vo., 2s. 6d.

GOODMAN.—MECHANICS APPLIED TO ENGINEERING. By JOHN GOODMAN, Wh.Sch., A.M.I.C.E., M.I.M.E., Professor of Engineering in the Yorkshire College, Leeds (Victoria University). With 620 Illustrations and numerous examples. Crown 8vo., 7s. 6d. net.

GRIEVE.—LESSONS IN ELEMENTARY MECHANICS. By W. H. GRIEVE, late Engineer, R.N., Science Demonstrator for the London School Board, etc.

1. With 165 Illustrations and a large number of Examples. Fcp. 8vo., 1s. 6d.

Stage 2. With 122 Illustrations. Fcp. 8vo., 1s. 6d.

Stage 3. With 103 Illustrations. Fcp. 8vo., 1s. 6d.

MECHANICS, DYNAMICS, STATICS, HYDROSTATICS, ETC.—

Continued.

MAGNUS.—Works by SIR PHILIP MAGNUS, B.Sc., B.A.

LESSONS IN ELEMENTARY MECHANICS. Introductory to the study of Physical Science. Designed for the Use of Schools, and of Candidates for the London Matriculation and other Examinations. With numerous Exercises, Examples, Examination Questions, and Solutions, etc., from 1870-1895. With Answers, and 131 Woodcuts. Fcp. 8vo., 3s. 6d.

Key for the use of Teachers only, price 5s. 3½d.

HYDROSTATICS AND PNEUMATICS. Fcp. 8vo., 1s. 6d.; or, with Answers, 2s. The Worked Solutions of the Problems, 2s.

PULLEN.—**MECHANICS:** Theoretical, Applied, and Experimental. By W. W. F. PULLEN, Wh.Sch., M.I.M.E., A.M.I.C.E. With 318 Diagrams and numerous Examples. Crown 8vo., 4s. 6d.

ROBINSON.—**ELEMENTS OF DYNAMICS** (Kinetics and Statics). With numerous Exercises. A Text-book for Junior Students. By the Rev. J. L. ROBINSON, M.A. Crown 8vo., 6s.

SMITH.—Works by J. HAMBLIN SMITH, M.A.

ELEMENTARY STATICS. Crown 8vo., 3s.

ELEMENTARY HYDROSTATICS. Crown 8vo., 3s.

KEY TO STATICS AND HYDROSTATICS. Crown 8vo., 6s.

TARLETON.—**AN INTRODUCTION TO THE MATHEMATICAL THEORY OF ATTRACTION.** By FRANCIS A. TARLETON, LL.D., Sc.D., Fellow of Trinity College, and Professor of Natural Philosophy in the University of Dublin. Crown 8vo., 10s. 6d.

TAYLOR.—Works by J. E. TAYLOR, M.A., B.Sc. (Lond.).

THEORETICAL MECHANICS, including Hydrostatics and Pneumatics. With 175 Diagrams and Illustrations, and 522 Examination Questions and Answers. Crown 8vo., 2s. 6d.

THEORETICAL MECHANICS—SOLIDS. With 103 Illustrations, 120 Worked Examples and over 500 Examples from Examination Papers, etc. Crown 8vo., 2s. 6d.

THEORETICAL MECHANICS.—FLUIDS. With 122 Illustrations, numerous Worked Examples, and about 500 Examples from Examination Papers, etc. Crown 8vo., 2s. 6d.

THORNTON.—**THEORETICAL MECHANICS—SOLIDS.**

Including Kinematics, Statics and Kinetics. By ARTHUR THORNTON, M.A., F.R.A.S. With 200 Illustrations, 130 Worked Examples, and over 900 Examples from Examination Papers, etc. Crown 8vo., 4s. 6d.

MECHANICS, DYNAMICS, STATICS, HYDROSTATICS, ETC.—
Continued.

TWISDEN.—Works by the Rev. JOHN F. TWISDEN, M.A.

PRACTICAL MECHANICS; an Elementary Introduction to their Study. With 855 Exercises, and 184 Figures and Diagrams. Crown 8vo., 10s. 6d.

THEORETICAL MECHANICS. With 172 Examples, numerous Exercises, and 154 Diagrams. Crown 8vo., 8s. 6d.

WILLIAMSON.—INTRODUCTION TO THE MATHEMATICAL THEORY OF THE STRESS AND STRAIN OF ELASTIC SOLIDS. By BENJAMIN WILLIAMSON, D.Sc., F.R.S. Crown 8vo., 5s.

WILLIAMSON AND TARLETON.—AN ELEMENTARY TREATISE ON DYNAMICS. Containing Applications to Thermodynamics, with numerous Examples. By BENJAMIN WILLIAMSON, D.Sc., F.R.S., and FRANCIS A. TARLETON, LL.D. Crown 8vo., 10s. 6d.

WORTHINGTON.—DYNAMICS OF ROTATION: an Elementary Introduction to Rigid Dynamics. By A. M. WORTHINGTON, M.A., F.R.S. Crown 8vo., 4s. 6d.

MENSURATION, SURVEYING, ETC.

BRABANT.—THE ELEMENTS OF PLANE AND SOLID MENSURATION. With Copious Examples and Answers. By F. G. BRABANT, M.A. Crown 8vo., 3s. 6d.

GRIBBLE.—PRELIMINARY SURVEY AND ESTIMATES. By THEODORE GRAHAM GRIBBLE, Civil Engineer. Including Elementary Astronomy, Route Surveying, Tacheometry, Curve Ranging, Graphic Mensuration, Estimates, Hydrography and Instruments. With 133 Illustrations, Quantity Diagrams, and a Manual of the Slide-Rule. Fcp. 8vo., 7s. 6d.

LODGE.—MENSURATION FOR SENIOR STUDENTS. By ALFRED LODGE, M.A., late Fereday Fellow of St. John's College, Oxford; Professor of Pure Mathematics at the Royal Indian Engineering College, Cooper's Hill. With Answers. Crown 8vo., 4s. 6d.

LUPTON.—A PRACTICAL TREATISE ON MINE SURVEYING. By ARNOLD LUPTON, Mining Engineer, Certificated Colliery Manager, Surveyor, Member of the Institution of Civil Engineers, etc. With 216 Illustrations. Medium 8vo., 12s. net.

NESBIT.—PRACTICAL MENSURATION. By A. NESBIT. Illustrated by 700 Practical Examples and 700 Woodcuts. 12mo., 3s. 6d. KEY, 5s.

SMITH.—CIRCULAR SLIDE RULE. By G. L. SMITH. Fcp. 8vo., 1s. net.

ALGEBRA, ETC.

* * For other Books, see Longmans & Co.'s Catalogue of Educational and School Books.

ANNALS OF MATHEMATICS. (*PUBLISHED UNDER THE AUSPICES OF HARVARD UNIVERSITY.*) Issued Quarterly. 4to., 2s. net.

BURNSIDE AND PANTON.—Works by WILLIAM SNOW BURNSIDE, M.A., Fellow of Trinity College, Dublin; and ARTHUR WILLIAM PANTON, M.A., Fellow and Tutor of Trinity College, Dublin.

THE THEORY OF EQUATIONS. With an Introduction to the Theory of Binary Algebraic Forms. 2 vols. 8vo., 9s. 6d. each.

AN INTRODUCTION TO DETERMINANTS: being a Chapter from the Theory of Equations (being the First Chapter of the Second Volume of 'The Theory of Equations'). 8vo., sewed, 2s. 6d.

CRACKNELL.—PRACTICAL MATHEMATICS. By A. G. CRACKNELL, M.A., B.Sc., Sixth Wrangler, etc. With Answers to the Examples. Crown 8vo., 3s. 6d.

GRIFFIN.—Works by Rev. WILLIAM NATHANIEL GRIFFIN, B.D., sometime Fellow of St. John's College, Cambridge.

THE ELEMENTS OF ALGEBRA AND TRIGONOMETRY.
Fcp. 8vo., 3s. 6d.

NOTES ON THE ELEMENTS OF ALGEBRA AND TRIGONOMETRY. With Solutions of the more Difficult Questions. Fcp. 8vo., 3s. 6d.

MELLOR.—HIGHER MATHEMATICS FOR STUDENTS OF CHEMISTRY AND PHYSICS. With special reference to Practical Work. By J. W. MELLOR, D.Sc., Research Fellow, The Owens College, Manchester. With 142 Diagrams. 8vo., 12s. 6d. net.

WELSFORD AND MAYO.—ELEMENTARY ALGEBRA. By J. W. WELSFORD, M.A., formerly Fellow of Gonville and Caius College, Cambridge, and C. H. P. MAYO, M.A., formerly Scholar of St. Peter's College, Cambridge; Assistant Masters at Harrow School. Crown 8vo., 3s. 6d., or with Answers, 4s. 6d.

CONIC SECTIONS, ETC.

CASEY.—A TREATISE ON THE ANALYTICAL GEOMETRY OF THE POINT, LINE, CIRCLE, AND CONIC SECTIONS. By JOHN CASEY, LL.D., F.R.S. Crown 8vo., 12s.

RICHARDSON.—GEOMETRICAL CONIC SECTIONS. By G. RICHARDSON, M.A. Crown 8vo., 4s. 6d.

SALMON.—A TREATISE ON CONIC SECTIONS, containing an Account of some of the most Important Modern Algebraic and Geometric Methods. By G. SALMON, D.D., F.R.S. 8vo., 12s.

SMITH.—GEOMETRICAL CONIC SECTIONS. By J. HAMBLIN SMITH, M.A. Crown 8vo., 3s. 6d.

THE CALCULUS, LOGARITHMS, ETC.

BARKER.—GRAPHICAL CALCULUS. By ARTHUR H. BARKER, B.A., B.Sc. With an Introduction by JOHN GOODMAN, A.M. I.C.E. With 61 Diagrams. Crown 8vo., 4s. 6d.

MURRAY.—Works by DANIEL ALEXANDER MURRAY, Ph.D.
AN INTRODUCTORY COURSE IN DIFFERENTIAL EQUATIONS. Crown 8vo., 4s. 6d.

A FIRST COURSE IN THE INFINITESIMAL CALCULUS. Crown 8vo., 7s. 6d.

O'DEA.—AN ELEMENTARY TREATISE ON LOGARITHMS, EXPONENTIAL AND LOGARITHMIC SERIES, UNDETERMINED CO-EFFICIENTS, AND THE THEORY OF DETERMINANTS. By JAMES J. O'DEA, M.A. Crown 8vo., 2s.

TATE.—PRINCIPLES OF THE DIFFERENTIAL AND INTEGRAL CALCULUS. By THOMAS TATE. 12mo., 4s. 6d.

WILLIAMSON.—Works by BENJAMIN WILLIAMSON, D.Sc.
AN ELEMENTARY TREATISE ON THE DIFFERENTIAL CALCULUS; containing the Theory of Plane Curves with numerous Examples. Crown 8vo., 10s. 6d.

AN ELEMENTARY TREATISE ON THE INTEGRAL CALCULUS; containing Applications to Plane Curves and Surfaces, and also a Chapter on the Calculus of Variations, with numerous Examples. Crown 8vo., 10s. 6d.

GEOMETRY AND EUCLID.

. For other Works, see Longmans & Co.'s Catalogue of Educational and School Books.

ALLMAN.—GREEK GEOMETRY FROM THALES TO EUCLID. By G. J. ALLMAN. 8vo., 10s. 6d.

BARRELL.—ELEMENTARY GEOMETRY. By FRANK R. BARRELL, M.A., B.Sc., Professor of Mathematics, University College, Bristol.

Section I. Part I., being the subject-matter of Euclid, Book I. Crown 8vo., 1s.

Section I. Part II., containing the subject-matter of Euclid, Book III. 1-34, and Book IV. 4-9. Crown 8vo., 1s.

Section I. complete. Crown 8vo., 2s.

Section II., containing the remainder of Euclid, Books III. and IV., together with the subject-matter of Books II. and VI. With explanation of Ratio and Proportion, Trigonometric Ratios and Measurement of Circles. Crown 8vo., 1s. 6d.

Sections I. and II. in one volume. Crown 8vo., 3s. 6d.

Section III., containing the subject-matter of Euclid, Book XI., together with a full treatment of volume and surface of the cylinder, cone, sphere, etc.

[In preparation.]

CASEY.—Works by JOHN CASEY, LL.D., F.R.S.

THE ELEMENTS OF EUCLID, BOOKS I.-VI. and Propositions, I.-XXI. of Book XI., and an Appendix of the Cylinder, Sphere, Cone, etc. With Copious Annotations and numerous Exercises. Fcp. 8vo., 4s. 6d. KEY to Exercises. Fcp. 8vo., 6s.

A SEQUEL TO THE ELEMENTS OF EUCLID. Part I. Books I.-VI. With numerous Examples. Fcp. 8vo., 3s. 6d.

A TREATISE ON THE ANALYTICAL GEOMETRY OF THE POINT, LINE, CIRCLE AND CONIC SECTIONS. Containing an Account of its most recent Extension. Crown 8vo., 12s.

GEOMETRY AND EUCLID—Continued.

HAMILTON.—ELEMENTS OF QUATERNIONS. By the late Sir WILLIAM ROWAN HAMILTON, LL.D., M.R.I.A. Edited by CHARLES JASPER JOLY, M.A., Fellow of Trinity College, Dublin. 2 vols. 4to. 21s. net each.

HIME.—THE OUTLINES OF QUATERNIONS. By Lieut.-Colonel H. W. L. HIME, late Royal Artillery. Crown 8vo., 10s.

LONGMANS' LIST OF APPARATUS FOR USE IN GEOMETRY, ETC.

1. LONGMANS' ENGLISH AND METRIC RULER. Marked on one edge in Inches, Eighths, Tenths and Five-fifths. Marked on the other edge in Centimetres. Price 1*d.* net.
2. LOW'S IMPROVED SET SQUARES. Designs A & B. 45° to 60°.

A 1 45° 4''	}	B 1 45° 4''	each	1/-	net.	A 1 60° 4''	}	B 1 60° 4''	each	1/-	net.
A 2 45° 6''		B 2 45° 6''	..	1/3	..	A 2 60° 6''		B 2 60° 6''	..	1/3	..
A 3 45° 6½''		B 3 45° 8½''	..	2/-	..	A 3 60° 8½''		B 3 60° 8½''	..	2/-	..
3. LOW'S IMPROVED PROTRACTORS (Celluloid). Protractor No. 2. 3'' radius, marked in degrees, 6*d.* net. Protractor No. 3. 4'' radius, marked in ½-degrees, 9*d.* net.
4. LOW'S ADJUSTABLE PROTRACTOR SET SQUARE. 2*s.* 6*d.* net.

LOW.—TEXT-BOOK ON PRACTICAL, SOLID, AND DESCRIPTIVE GEOMETRY. By DAVID ALLAN LOW, Professor of Engineering, East London Technical College. Crown 8vo.

Part I. With 114 Figures, 2*s.* Part II. With 64 Figures, 3*s.*

MORRIS AND HUSBAND.—PRACTICAL PLANE AND SOLID GEOMETRY. By I. HAMMOND MORRIS and JOSEPH HUSBAND. Fully Illustrated with Drawings. Crown 8vo., 2*s.* 6*d.*

MORRIS.—GEOMETRICAL DRAWING FOR ART STUDENTS. Embracing Plane Geometry and its Applications, the Use of Scales, and the Plans and Elevations of Solids as required in Section I. of Science Subjects. By I. HAMMOND MORRIS. Crown 8vo., 2*s.*

SMITH.—ELEMENTS OF GEOMETRY. By J. HAMBLIN SMITH, M.A. Containing Books 1 to 6, and portions of Books 11 and 12, of Euclid, with Exercises and Notes. Cr. 8vo., 3*s.* 6*d.* KEY, crown 8vo., 8*s.* 6*d.* Books 1 and 2, limp cloth, 1*s.* 6*d.*, may be had separately.

SPOONER.—THE ELEMENTS OF GEOMETRICAL DRAWING: an Elementary Text-book on Practical Plane Geometry, including an Introduction to Solid Geometry. Written to include the requirements of the Syllabus of the Board of Education in Geometrical Drawing and for the use of Students preparing for the Military Entrance Examinations. By HENRY J. SPOONER, C.E., M.Inst.M.E. Crown 8vo., 3*s.* 6*d.*

WATSON.—ELEMENTS OF PLANE AND SOLID GEOMETRY. By H. W. WATSON, M.A. Fcp. 8vo., 3*s.* 6*d.*

WILSON.—GEOMETRICAL DRAWING. For the use of Candidates for Army Examinations, and as an Introduction to Mechanical Drawing. By W. N. WILSON, M.A. Parts I. and II. Crown 8vo., 4*s.* 6*d.* each

WINTER.—ELEMENTARY GEOMETRICAL DRAWING. By S. H. WINTER.

Part I. Including Practical Plane Geometry, the Construction of Scales, the Use of the Sector, the Marquis Scales, and the Protractor. With 3 Plates and 1000 Exercises and Examination Papers. Post 8vo., 5*s.*

TRIGONOMETRY.

- CASEY.**—A TREATISE ON ELEMENTARY TRIGONOMETRY. By JOHN CASEY, LL.D., F.R.S., late Fellow of the Royal University of Ireland. With numerous Examples and Questions for Examination. 12mo., 3s.
- CLARKE.**—PLANE TRIGONOMETRY. Containing the more advanced Propositions, Solution of Problems and a complete Summary of Formulæ, Bookwork, etc., together with recent Examination Papers for the Army, Woolwich, etc. With Answers. By the Rev. A. DAWSON CLARKE, M.A., St. John's College, Cambridge. Crown 8vo., 5s.
- GOODWIN.**—Works by H. B. GOODWIN, M.A.
- PLANE AND SPHERICAL TRIGONOMETRY. In Three Parts, comprising those portions of the subjects, theoretical and practical, which are required in the Final Examination for Rank of Lieutenant at Greenwich. 8vo., 8s. 6d.
- ELEMENTARY PLANE TRIGONOMETRY. With numerous Examples and Examination Papers set at the Royal Naval College in recent years. With Answers. 8vo., 5s.
- JONES.**—THE BEGINNINGS OF TRIGONOMETRY. By A. CLEMENT JONES, M.A., Ph.D., late Open Scholar and Senior Hulme Exhibitor of Brasenose College, Oxford; Senior Mathematical Master of Bradford Grammar School. Crown 8vo., 2s.
- MURRAY.**—Works by DANIEL A. MURRAY, B.A., Ph.D.
- PLANE TRIGONOMETRY. Crown 8vo., 3s. 6d. With Logarithmic and Trigonometric Tables. Crown 8vo., 5s.
- SPHERICAL TRIGONOMETRY. With Answers. Crown 8vo., 2s. 6d.
- PLANE AND SPHERICAL TRIGONOMETRY. With Answers. Crown 8vo., 6s.
- SMITH.**—ELEMENTARY TRIGONOMETRY. By J. HAMBLIN SMITH, M.A. Crown 8vo., 4s. 6d. Key, 7s. 6d.

OPTICS, PHOTOGRAPHY, ETC.

- ABNEY.**—A TREATISE ON PHOTOGRAPHY. By Sir WILLIAM DE WIVELESLE ABNEY, K.C.B., F.R.S., Principal Assistant Secretary of the Secondary Department of the Board of Education. With 134 Illustrations. Fcp. 8vo., 5s.
- DRUDE.**—THE THEORY OF OPTICS. By PAUL DRUDE, Professor of Physics at the University of Giessen. Translated from the German by C. RIBORG MANN and ROBERT A. MILLIKAN, Assistant Professors of Physics at the University of Chicago. With 110 Diagrams. 8vo., 15s. net.
- GLAZEBROOK.**—PHYSICAL OPTICS. By R. T. GLAZEBROOK, M.A., F.R.S., Principal of University College, Liverpool. With 183 Woodcuts of Apparatus, etc. Fcp. 8vo., 6s.
- VANDERPOEL.**—COLOR PROBLEMS: a Practical Manual for the Lay Student of Color. By EMILY NOYES VANDERPOEL. With 117 Plates in Color. Square 8vo., 21s. net.
- WRIGHT.**—OPTICAL PROJECTION: a Treatise on the Use of the Lantern in Exhibition and Scientific Demonstration. By LEWIS WRIGHT, Author of 'Light: a Course of Experimental Optics'. With 232 Illustrations. Crown 8vo., 6s.

SOUND, LIGHT, HEAT, AND THERMODYNAMICS.

DEXTER.—ELEMENTARY PRACTICAL SOUND, LIGHT AND HEAT. By JOSEPH S. DEXTER, B.Sc. (Lond.), Physics Master, Technical Day School, The Polytechnic Institute, Regent Street. With 152 Illustrations. Crown 8vo., 2s. 6d.

EMTAGE.—LIGHT. By W. T. A. EMTAGE, M.A., Director of Public Instruction, Mauritius. With 232 Illustrations. Crown 8vo., 6s.

HELMHOLTZ.—ON THE SENSATIONS OF TONE AS A PHYSIOLOGICAL BASIS FOR THE THEORY OF MUSIC. By HERMANN VON HELMHOLTZ. Royal 8vo., 28s.

MAXWELL.—THEORY OF HEAT. By J. CLERK MAXWELL, M.A., F.R.S.S., L. and E. With Corrections and Additions by Lord RAY LEIGH. With 38 Illustrations. Fcp. 8vo., 4s. 6d.

PLANCK.—TREATISE ON THERMODYNAMICS. By Dr. MAX PLANCK, Professor of Theoretical Physics in the University of Berlin. Translated, with the Author's sanction, by ALEXANDER OGG, M.A., B.Sc., Ph.D., late 1851 Exhibition Scholar, Aberdeen University; Assistant Master, Royal Naval Engineering College, Devonport. 8vo., 7s. 6d. net.

SMITH.—THE STUDY OF HEAT. By J. HAMBLIN SMITH, M.A., of Gonville and Caius College, Cambridge. Crown 8vo., 3s.

TYNDALL.—Works by JOHN TYNDALL, D.C.L., F.R.S.
See p. 36.

WORMELL.—A CLASS-BOOK OF THERMODYNAMICS. By RICHARD WORMELL, B.Sc., M.A. Fcp. 8vo., 1s. 6d.

WRIGHT.—Works by MARK R. WRIGHT, M.A.

SOUND, LIGHT, AND HEAT. With 160 Diagrams and Illustrations. Crown 8vo., 2s. 6d.

ADVANCED HEAT. With 136 Diagrams and numerous Examples and Examination Papers. Crown 8vo., 4s. 6d.

STEAM, OIL, AND GAS ENGINES.

BALE.—A HAND-BOOK FOR STEAM USERS; being Rules for Engine Drivers and Boiler Attendants, with Notes on Steam Engine and Boiler Management and Steam Boiler Explosions. By M. POWIS BALE, M.I.M.E., A.M.I.C.E. Fcp. 8vo., 2s. 6d.

CLERK.—THE GAS AND OIL ENGINE. By DUGALD CLERK, Member of the Institution of Civil Engineers, Fellow of the Chemical Society, Member of the Royal Institution, Fellow of the Institute of Patent Agents. With 228 Illustrations. 8vo., 15s.

STEAM, OIL, AND GAS ENGINES—Continued.

- HOLMES.**—THE STEAM ENGINE. By GEORGE C. V. HOLMES, Chairman of the Board of Works, Ireland. With 212 Illustrations. Fcp. 8vo., 6s.
- NEILSON.**—THE STEAM TURBINE. By ROBERT M. NEILSON, Whitworth Exhibitioner, Associate Member of the Institute of Mechanical Engineers, Lecturer on Steam and the Steam Engine at the Heginbottom Technical School, Ashton-under-Lyne. With 212 Illustrations. 8vo., 10s. 6d. net.
- NORRIS.**—A PRACTICAL TREATISE ON THE 'OTTO' CYCLE GAS ENGINE. By WILLIAM NORRIS, M.I.Mech.E. With 207 Illustrations. 8vo., 10s. 6d.
- PARSONS.**—STEAM BOILERS: THEIR THEORY AND DESIGN. By H. DE B. PARSONS, B.S., M.E., Consulting Engineer; Member of the American Society of Mechanical Engineers, American Society of Civil Engineers, etc.; Professor of Steam Engineering, Rensselaer Polytechnic Institute. With numerous Illustrations. 8vo.
- RIPPER.**—Works by WILLIAM RIPPER, Professor of Engineering in the Technical Department of University College, Sheffield.
- STEAM. With 185 Illustrations. Crown 8vo., 2s. 6d.
- STEAM ENGINE THEORY AND PRACTICE. With 441 Illustrations. 8vo., 9s.
- SENNETT AND ORAM.**—THE MARINE STEAM ENGINE: A Treatise for Engineering Students, Young Engineers and Officers of the Royal Navy and Mercantile Marine. By the late RICHARD SENNETT, Engineer-in-Chief of the Navy, etc.; and HENRY J. ORAM, Deputy Engineer-in-Chief at the Admiralty, Engineer Rear Admiral in H.M. Fleet, etc. With 414 Diagrams. 8vo., 21s.
- STROMEYER.**—MARINE BOILER MANAGEMENT AND CONSTRUCTION. Being a Treatise on Boiler Troubles and Repairs, Corrosion, Fuels, and Heat, on the properties of Iron and Steel, on Boiler Mechanics, Workshop Practices, and Boiler Design. By C. E. STROMEYER, Chief Engineer of the Manchester Steam Users' Association, Member of Council of the Institution of Naval Architects, etc. With 452 Diagrams, etc. 8vo., 12s. net.
- ARCHITECTURE, BUILDING CONSTRUCTION, ETC.**
- ADVANCED BUILDING CONSTRUCTION.** By the Author of 'Rivingtons' Notes on Building Construction'. With 385 Illustrations. Crown 8vo., 4s. 6d.
- BURRELL.**—BUILDING CONSTRUCTION. By EDWARD J. BURRELL, Second Master of the People's Palace Technical School, London. With 303 Working Drawings. Crown 8vo., 2s. 6d.
- GWILT.**—AN ENCYCLOPÆDIA OF ARCHITECTURE. By JOSEPH GWILT, F.S.A. Revised (1888), with Alterations and Considerable Additions by WYATT PAPWORTH. With 1700 Engravings. 8vo., 21s. net.
- PARKER AND UNWIN.**—THE ART OF BUILDING A HOME: A Collection of Lectures and Illustrations. By BARRY PARKER and RAYMOND UNWIN. With 68 Full-page Plates. 8vo., 10s. 6d. net.
- RICHARDS.**—BRICKLAYING AND BRICKCUTTING. By H. W. RICHARDS, Examiner in Brickwork and Masonry to the City and Guilds of London Institute, Head of Building Trades Department, Northern Polytechnic Institute, London, N. With over 200 Illustrations. 8vo., 3s. 6d.

ARCHITECTURE, BUILDING CONSTRUCTION, ETC.—Continued.

SEDDON.—**BUILDER'S WORK AND THE BUILDING TRADES.** By Col. H. C. SEDDON, R.E. With numerous Illustrations. Medium 8vo., 16s.

THOMAS.—**THE VENTILATION, HEATING AND MANAGEMENT OF CHURCHES AND PUBLIC BUILDINGS.** By J. W. THOMAS, F.I.C., F.C.S., Author of 'Coal, Mine-Gases, and Ventilation,' etc. With 25 Illustrations. Crown 8vo., 2s. 6d.

VALDER.—**BOOK OF TABLES,** giving the Cubic Contents of from One to Thirty Pieces Deals, Battens and Scantlings of the Sizes usually imported or used in the Building Trades, together with an Appendix showing a large number of sizes, the Contents of which may be found by referring to the aforesaid Tables. By THOMAS VALDER. Oblong 4to., 6s. net.

RIVINGTONS' COURSE OF BUILDING CONSTRUCTION.

NOTES ON BUILDING CONSTRUCTION. Medium 8vo.

Part I. With 552 Illustrations, 9s. net.

Part II. With 479 Illustrations, 9s. net.

Part III. Materials. With 188 Illustrations, 18s. net.

Part IV. Calculations for Building Structures. With 551 Illustrations, 13s. net.

ELECTRICITY AND MAGNETISM.

ARRHENIUS.—**A TEXT-BOOK OF ELECTROCHEMISTRY.** By SVANTE ARRHENIUS, Professor at the University of Stockholm. Translated from the German Edition by JOHN MCCRAE, Ph.D. With 58 Illustrations. 8vo., 9s. 6d. net.

CARUS-WILSON.—**ELECTRO-DYNAMICS: the Direct-Current Motor.** By CHARLES ASHLEY CARUS-WILSON, M.A. Cantab. With 71 Diagrams, and a Series of Problems, with Answers. Crown 8vo., 7s. 6d.

CUMMING.—**ELECTRICITY TREATED EXPERIMENTALLY.** By LINNÆUS CUMMING, M.A. With 242 Illustrations. Cr. 8vo., 4s. 6d.

DAY.—**EXERCISES IN ELECTRICAL AND MAGNETIC MEASUREMENTS,** with Answers. By R. E. DAY. 12mo., 3s. 6d.

FITZGERALD.—**THE SCIENTIFIC WRITINGS OF THE LATE GEORGE FRANCIS FITZGERALD,** Sc.D., F.R.S., F.R.S.E., Fellow of Trinity College, Dublin. Collected and Edited, with an Historical Introduction, by JOSEPH LARMOR, Sec.R.S., Fellow of St. John's College, Cambridge. With Portrait. 8vo., 15s.

GORE.—**THE ART OF ELECTRO-METALLURGY,** including all known Processes of Electro-Deposition. By G. GORE, LL.D., F.R.S. With 56 Illustrations. Fcp. 8vo., 6s.

HENDERSON.—**Works by JOHN HENDERSON,** D.Sc., F.R.S.E. **PRACTICAL ELECTRICITY AND MAGNETISM.** With 159 Illustrations and Diagrams. Crown 8vo., 6s. 6d.

PRELIMINARY PRACTICAL MAGNETISM AND ELECTRICITY. Crown 8vo., 1s.

ELECTRICITY AND MAGNETISM—Continued.

JENKIN.—ELECTRICITY AND MAGNETISM. By FLEEMING JENKIN, F.R.S., M.I.C.E. With 177 Illustrations. Fcp. 8vo., 3s. 6d.

JOUBERT.—ELEMENTARY TREATISE ON ELECTRICITY AND MAGNETISM. By G. CAREY FOSTER, F.R.S., Fellow and Emeritus Professor of Physics in University College, London; and ALFRED W. PORTER, B.Sc., Fellow and Assistant Professor of Physics in University College, London. Founded on JOUBERT'S 'Traité Élémentaire d'Electricité'. Second Edition. With 374 Illustrations and Diagrams. 8vo., 10s. 6d. net.

JOYCE.—EXAMPLES IN ELECTRICAL ENGINEERING. By SAMUEL JOYCE, A.I.E.E. Crown 8vo., 5s.

MACLEAN AND MARCHANT.—ELEMENTARY QUESTIONS IN ELECTRICITY AND MAGNETISM. With Answers. Compiled by MAGNUS MACLEAN, D.Sc., M.I.E.E., and E. W. MARCHANT, D.Sc., A.I.E.E. Crown 8vo., 1s.

MERRIFIELD.—MAGNETISM AND DEVIATION OF THE COMPASS. By JOHN MERRIFIELD, LL.D., F.R.A.S., 18mo., 2s. 6d.

PARR.—PRACTICAL ELECTRICAL TESTING IN PHYSICS AND ELECTRICAL ENGINEERING. By G. D. ASPINALL PARR, Assoc. M.I.E.E. With 231 Illustrations. 8vo., 8s. 6d.

POYSER.—Works by A. W. POYSER, M.A.

MAGNETISM AND ELECTRICITY. With 235 Illustrations. Crown 8vo., 2s. 6d.

ADVANCED ELECTRICITY AND MAGNETISM. With 317 Illustrations. Crown 8vo., 4s. 6d.

RHODES.—AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. RHODES, M.Sc. (Vict.), Consulting Engineer. With 80 Diagrams. 8vo., 7s. 6d. net.

SLINGO AND BROOKER.—Works by W. SLINGO and A. BROOKER.

ELECTRICAL ENGINEERING FOR ELECTRIC LIGHT ARTISANS AND STUDENTS. With 383 Illustrations. Crown 8vo., 12s.

PROBLEMS AND SOLUTIONS IN ELEMENTARY ELECTRICITY AND MAGNETISM. With 98 Illustrations. Cr. 8vo., 2s.

TYNDALL.—Works by JOHN TYNDALL, D.C.L., F.R.S. See p. 36.

TELEGRAPHY AND THE TELEPHONE.

HOPKINS.—TELEPHONE LINES AND THEIR PROPERTIES. By WILLIAM J. HOPKINS, Professor of Physics in the Drexel Institute, Philadelphia. Crown 8vo., 6s.

PREECE AND SIVEWRIGHT.—TELEGRAPHY. By Sir W. H. PREECE, K.C.B., F.R.S., V.P.Inst., C.E., etc., Consulting Engineer and Electrician, Post Office Telegraphs; and Sir J. SIVEWRIGHT, K.C.M.G., General Manager, South African Telegraphs. With 267 Illustrations. Fcp. 8vo., 6s.

ENGINEERING, STRENGTH OF MATERIALS, ETC.

ANDERSON.—THE STRENGTH OF MATERIALS AND STRUCTURES: the Strength of Materials as depending on their Quality and as ascertained by Testing Apparatus. By Sir J. ANDERSON, C.E., LL.D., F.R.S.E. With 66 Illustrations. Fcp. 8vo., 3s. 6d.

BARRY.—RAILWAY APPLIANCES: a Description of Details of Railway Construction subsequent to the completion of the Earthworks and Structures. By Sir JOHN WOLFE BARRY, K.C.B., F.R.S., M.I.C.E. With 218 Illustrations. Fcp. 8vo., 4s. 6d.

DIPLOCK.—A NEW SYSTEM OF HEAVY GOODS TRANSPORT ON COMMON ROADS. By BRAHAM JOSEPH DIPLOCK. With 27 Illustrations. 8vo., 6s. 6d. net.

GOODMAN.—MECHANICS APPLIED TO ENGINEERING. By JOHN GOODMAN, Wh.Sch., A.M.I.C.E., M.I.M.E., Professor of Engineering in the Yorkshire College, Leeds (Victoria University). With 620 Illustrations and numerous Examples. Crown 8vo., 7s. 6d. net.

LOW.—A POCKET-BOOK FOR MECHANICAL ENGINEERS. By DAVID ALLAN LOW (Whitworth Scholar), M.I.Mech.E., Professor of Engineering, East London Technical College (People's Palace), London. With over 1000 specially prepared Illustrations. Fcp. 8vo., gilt edges, rounded corners, 7s. 6d.

PARKINSON.—LIGHT RAILWAY CONSTRUCTION. By RICHARD MARION PARKINSON, Assoc.M.Inst.C.E. With 85 Diagrams. 8vo., 10s. 6d. net.

SMITH.—GRAPHICS, or the Art of Calculation by Drawing Lines, applied especially to Mechanical Engineering. By ROBERT H. SMITH, Professor of Engineering, Mason College, Birmingham. Part I. With separate Atlas of 29 Plates containing 97 Diagrams. 8vo., 15s.

STONEY.—THE THEORY OF STRESSES IN GIRDERS AND SIMILAR STRUCTURES; with Practical Observations on the Strength and other Properties of Materials. By BINDON B. STONEY, LL.D., F.R.S., M.I.C.E. With 5 Plates and 143 Illust. in the Text. Royal 8vo., 36s.

UNWIN.—THE TESTING OF MATERIALS OF CONSTRUCTION. A Text-book for the Engineering Laboratory and a Collection of the Results of Experiment. By W. CAWTHORNE UNWIN, F.R.S., B.Sc. With 5 Plates and 188 Illustrations and Diagrams. 8vo., 16s. net.

WARREN.—ENGINEERING CONSTRUCTION IN IRON, STEEL, AND TIMBER. By WILLIAM HENRY WARREN, Challis Professor of Civil and Mechanical Engineering, University of Sydney. With 13 Folding Plates and 375 Diagrams. Royal 8vo., 16s. net.

WHEELER.—THE SEA COAST: Destruction, Littoral Drift, Protection. By W. H. WHEELER, M.Inst. C.E. With 38 Illustrations and Diagram. Medium 8vo., 10s. 6d. net.

LONGMANS' CIVIL ENGINEERING SERIES.

CIVIL ENGINEERING AS APPLIED TO CONSTRUCTION.

By LEVESON FRANCIS VERNON-HARCOURT, M.A., M.Inst.C.E. With 368 Illustrations. Medium 8vo., 14s. net.

CONTENTS.—Materials, Preliminary Works, Foundations and Roads—Railway Bridge and Tunnel Engineering—River and Canal Engineering—Irrigation Works—Dock Works and Maritime Engineering—Sanitary Engineering.

NOTES ON DOCKS AND DOCK CONSTRUCTION. By C.

COLSON, C.B., M.Inst.C.E. With 365 Illustrations. Medium 8vo., 21s. net.

CALCULATIONS IN HYDRAULIC ENGINEERING: a

Practical Text-Book for the use of Students, Draughtsmen and Engineers. By T. CLAXTON FIDLER, M.Inst.C.E.

Part I. Fluid Pressure and the Calculation of its Effects in Engineering Structures. With numerous Illustrations and Examples. 8vo., 6s. 6d. net.

Part II. Calculations in Hydro-Kinetics. With numerous Illustrations and Examples. 8vo., 7s. 6d. net.

RAILWAY CONSTRUCTION. By W. H. MILLS, M.I.C.E.,

Engineer-in-Chief of the Great Northern Railway of Ireland. With 516 Illustrations and Diagrams. 8vo., 18s. net.

PRINCIPLES AND PRACTICE OF HARBOUR CON-

STRUCTION. By WILLIAM SHIELD, F.R.S.E., M.Inst.C.E. With 97 Illustrations. Medium 8vo., 15s. net.

TIDAL RIVERS: their (1) Hydraulics, (2) Improvement, (3)

Navigation. By W. H. WHEELER, M.Inst.C.E. With 75 Illustrations. Medium 8vo., 16s. net.

MACHINE DRAWING AND DESIGN.

LOW.—Works by DAVID ALLAN LOW, Professor of Engineering, East London Technical College (People's Palace).

IMPROVED DRAWING SCALES. 6d. net in case.

AN INTRODUCTION TO MACHINE DRAWING AND

DESIGN. With 153 Illustrations and Diagrams. Crown 8vo., 2s. 6d.

IMPROVED DRAWING APPLIANCES: Set-Squares, Adjust-

able Protractor Set-Squares, Tee-Squares, Protractors, Scales, etc.

* * * *A Detailed and Illustrated Prospectus will be sent on application.*

LOW AND BEVIS.—A MANUAL OF MACHINE DRAWING

AND DESIGN. By DAVID ALLAN LOW and ALFRED WILLIAM BEVIS M.I.Mech.E. With 700 Illustrations. 8vo., 7s. 6d.

UNWIN.—THE ELEMENTS OF MACHINE DESIGN. By

W. CAWTHORNE UNWIN, F.R.S.

Part I. General Principles, Fastenings, and Transmissive Machinery. With 345 Diagrams, etc. Fcp. 8vo., 7s. 6d.

Part II. Chiefly on Engine Details. With 259 Illustrations. Fcp. 8vo., 6s.

NAVAL ARCHITECTURE.

ATTWOOD.—TEXT-BOOK OF THEORETICAL NAVAL ARCHITECTURE: a Manual for Students of Science Classes and Draughtsmen Engaged in Shipbuilders' and Naval Architects' Drawing Offices. By EDWARD LEWIS ATTWOOD, Assistant Constructor, Royal Navy. With 114 Diagrams. Crown 8vo., 7s. 6d.

WATSON.—NAVAL ARCHITECTURE: A Manual of Laying-off Iron, Steel and Composite Vessels. By THOMAS H. WATSON, Lecturer on Naval Architecture at the Durham College of Science, Newcastle-upon-Tyne. With numerous Illustrations. Royal 8vo., 15s. net.

WORKSHOP APPLIANCES, ETC.

NORTHCOTT.—LATHES AND TURNING, Simple, Mechanical and Ornamental. By W. H. NORTHCOTT. With 338 Illustrations. 8vo., 18s.

SHELLEY.—WORKSHOP APPLIANCES, including Descriptions of some of the Gauging and Measuring Instruments, Hand-cutting Tools, Lathes, Drilling, Planing, and other Machine Tools used by Engineers. By C. P. B. SHELLEY, M.I.C.E. With an additional Chapter on Milling by R. R. LISTER. With 323 Illustrations. Fcp. 8vo., 5s.

MINERALOGY, MINING, METALLURGY, ETC.

BAUERMAN.—Works by HILARY BAUERMAN, F.G.S.
SYSTEMATIC MINERALOGY. With 373 Illustrations.
Fcp. 8vo., 6s.

DESCRIPTIVE MINERALOGY. With 236 Illustrations.
Fcp. 8vo., 6s.

BREARLEY AND IBBOTSON.—THE ANALYSIS OF STEEL-WORKS MATERIALS. By HARRY BREARLEY and FRED IBBOTSON, B.Sc. (Lond.), Demonstrator of Micrographic Analysis, University College, Sheffield. With 85 Illustrations. 8vo., 14s. net.

BREARLEY.—THE ANALYTICAL CHEMISTRY OF URANIUM. By HARRY BREARLEY, Joint Author of Brearley and Ibbotson's 'Analysis of Steel-Works Materials'. 8vo., 2s. net.

GORE.—THE ART OF ELECTRO-METALLURGY. By G. GORE, LL.D., F.R.S. With 56 Illustrations. Fcp. 8vo., 6s.

HUNTINGTON AND M'MILLAN.—METALS: their Properties and Treatment. By A. K. HUNTINGTON, Professor of Metallurgy in King's College, London, and W. G. M'MILLAN, Lecturer on Metallurgy in Mason's College, Birmingham. With 122 Illustrations. Fcp. 8vo., 7s. 6d.

LUPTON.—Works by ARNOLD LUPTON, M.I.C.E., F.G.S., etc.
MINING. An Elementary Treatise on the Getting of Minerals.
With 596 Diagrams and Illustrations. Crown 8vo., 9s. net.

A PRACTICAL TREATISE ON MINE SURVEYING.
With 209 Illustrations. 8vo., 12s. net.

RHEAD.—METALLURGY. By E. L. RHEAD, Lecturer on Metallurgy at the Municipal Technical School, Manchester. With 94 Illustrations. Fcp. 8vo., 3s. 6d.

MINERALOGY, MINING, METALLURGY, ETC.—*Continued.*

RHEAD AND SEXTON.—ASSAYING AND METALLURGICAL ANALYSIS for the use of Students, Chemists and Assayers. By E. L. RHEAD, Lecturer on Metallurgy, Municipal School of Technology, Manchester; and A. HUMBOLDT SEXTON, F.I.C., F.C.S., Professor of Metallurgy, Glasgow and West of Scotland Technical College. 8vo., 10s. 6d. net.

RUTLEY.—THE STUDY OF ROCKS: an Elementary Text-book of Petrology. By F. RUTLEY, F.G.S. With 6 Plates and 88 other Illustrations. Fcp. 8vo., 4s. 6d.

ASTRONOMY, NAVIGATION, ETC.

ABBOTT.—ELEMENTARY THEORY OF THE TIDES: the Fundamental Theorems Demonstrated without Mathematics and the Influence on the Length of the Day Discussed. By T. K. ABBOTT, B.D., Fellow and Tutor, Trinity College, Dublin. Crown 8vo., 2s.

BALL.—Works by Sir ROBERT S. BALL, LL.D., F.R.S.
ELEMENTS OF ASTRONOMY. With 130 Figures and Diagrams. Fcp. 8vo., 6s. 6d.

A CLASS-BOOK OF ASTRONOMY. With 41 Diagrams. Fcp. 8vo., 1s. 6d.

GILL.—TEXT-BOOK ON NAVIGATION AND NAUTICAL ASTRONOMY. By J. GILL, F.R.A.S., late Head Master of the Liverpool Corporation Nautical College. 8vo., 10s. 6d.

GOODWIN.—AZIMUTH TABLES FOR THE HIGHER DECLINATIONS. (Limits of Declination 24° to 30° , both inclusive.) Between the Parallels of Latitude 0° and 60° . With Examples of the Use of the Tables in English and French. By H. B. GOODWIN, Naval Instructor, Royal Navy. Royal 8vo., 7s. 6d.

HERSCHEL.—OUTLINES OF ASTRONOMY. By Sir JOHN F. W. HERSCHEL, Bart., K.H., etc. With 9 Plates and numerous Diagrams. 8vo., 12s.

LAUGHTON.—AN INTRODUCTION TO THE PRACTICAL AND THEORETICAL STUDY OF NAUTICAL SURVEYING. By JOHN KNOX LAUGHTON, M.A., F.R.A.S. With 35 Diagrams. Crown 8vo., 6s.

LOWELL.—MARS. By PERCIVAL LOWELL, Fellow American Academy, Member Royal Asiatic Society, Great Britain and Ireland, etc. With 24 Plates. 8vo., 12s. 6d.

MARTIN.—NAVIGATION AND NAUTICAL ASTRONOMY. Compiled by Staff Commander W. R. MARTIN, R.N. Royal 8vo., 18s.

MERRIFIELD.—A TREATISE ON NAVIGATION. For the Use of Students. By J. MERRIFIELD, LL.D., F.R.A.S., F.M.S. With Charts and Diagrams. Crown 8vo., 5s.

PARKER.—ELEMENTS OF ASTRONOMY. With Numerous Examples and Examination Papers. By GEORGE W. PARKER, M.A., of Trinity College, Dublin. With 84 Diagrams. 8vo., 5s. 6d. net.

WEBB.—CELESTIAL OBJECTS FOR COMMON TELESCOPES. By the Rev. T. W. WEBB, M.A., F.R.A.S. Fifth Edition, Revised and greatly Enlarged by the Rev. T. E. ESPIN, M.A., F.R.A.S. (Two Volumes.) Vol. I., with Portrait and a Reminiscence of the Author, 2 Plates, and numerous Illustrations. Crown 8vo., 6s. Vol. II., with numerous Illustrations. Crown 8vo., 6s. 6d.

WORKS BY RICHARD A. PROCTOR.

THE MOON: Her Motions, Aspect, Scenery, and Physical Condition. With many Plates and Charts, Wood Engravings, and 2 Lunar Photographs. Crown 8vo., 3s. 6d.

OTHER WORLDS THAN OURS: the Plurality of Worlds Studied Under the Light of Recent Scientific Researches. With 14 Illustrations; Map, Charts, etc. Crown 8vo., 3s. 6d.

OUR PLACE AMONG INFINITIES: a Series of Essays contrasting our Little Abode in Space and Time with the Infinities around us. Crown 8vo., 3s. 6d.

MYTHS AND MARVELS OF ASTRONOMY. Crown 8vo., 3s. 6d.

LIGHT SCIENCE FOR LEISURE HOURS: Familiar Essays on Scientific Subjects, Natural Phenomena, etc. Crown 8vo., 3s. 6d.

THE ORBS AROUND US; Essays on the Moon and Planets, Meteors and Comets, the Sun and Coloured Pairs of Suns. Crown 8vo., 3s. 6d.

THE EXPANSE OF HEAVEN: Essays on the Wonders of the Firmament. Crown 8vo., 3s. 6d.

OTHER SUNS THAN OURS: a Series of Essays on Suns—Old, Young, and Dead. With other Science Gleanings. Two Essays on Whist, and Correspondence with Sir John Herschel. With 9 Star-Maps and Diagrams. Crown 8vo., 3s. 6d.

HALF-HOURS WITH THE TELESCOPE: a Popular Guide to the Use of the Telescope as a means of Amusement and Instruction. With 7 Plates. Fcp. 8vo., 2s. 6d.

NEW STAR ATLAS FOR THE LIBRARY, the School, and the Observatory, in Twelve Circular Maps (with Two Index-Plates). With an Introduction on the Study of the Stars. Illustrated by 9 Diagrams. Cr. 8vo., 5s.

THE SOUTHERN SKIES: a Plain and Easy Guide to the Constellations of the Southern Hemisphere. Showing in 12 Maps the position of the principal Star-Groups night after night throughout the year. With an Introduction and a separate Explanation of each Map. True for every Year. 4to., 5s.

HALF-HOURS WITH THE STARS: a Plain and Easy Guide to the Knowledge of the Constellations. Showing in 12 Maps the position of the principal Star-Groups night after night throughout the year. With Introduction and a separate Explanation of each Map. True for every Year. 4to., 3s. net.

LARGER STAR ATLAS FOR OBSERVERS AND STUDENTS. In Twelve Circular Maps, showing 6000 Stars, 1500 Double Stars, Nebulæ, etc. With 2 Index-Plates. Folio, 15s.

WORKS BY RICHARD A. PROCTOR—Continued.

THE STARS IN THEIR SEASONS: an Easy Guide to a Knowledge of the Star-Groups. In 12 Large Maps. Imperial 8vo., 5s.

ROUGH WAYS MADE SMOOTH. Familiar Essays on Scientific Subjects. Crown 8vo., 3s. 6d.

PLEASANT WAYS IN SCIENCE. Crown 8vo., 3s. 6d.

NATURE STUDIES. By R. A. PROCTOR, GRANT ALLEN, A. WILSON, T. FOSTER, and E. CLODD. Crown 8vo., 3s. 6d.

LEISURE READINGS. By R. A. PROCTOR, E. CLODD, A. WILSON, T. FOSTER, and A. C. RANYARD. Crown 8vo., 3s. 6d.

PHYSIOGRAPHY AND GEOLOGY.

BIRD.—Works by CHARLES BIRD, B.A.

ELEMENTARY GEOLOGY. With Geological Map of the British Isles, and 247 Illustrations. Crown 8vo., 2s. 6d.

ADVANCED GEOLOGY. A Manual for Students in Advanced Classes and for General Readers. With over 300 Illustrations, a Geological Map of the British Isles (coloured), and a set of Questions for Examination. Crown 8vo., 7s. 6d.

GREEN.—PHYSICAL GEOLOGY FOR STUDENTS AND GENERAL READERS. By A. H. GREEN, M.A., F.G.S. With 236 Illustrations. 8vo., 21s.

MORGAN.—Works by ALEX. MORGAN, M.A., D.Sc., F.R.S.E.

ELEMENTARY PHYSIOGRAPHY. Treated Experimentally. With 4 Maps and 243 Diagrams. Crown 8vo., 2s. 6d.

ADVANCED PHYSIOGRAPHY. With 215 Illustrations. Crown 8vo., 4s. 6d.

READE.—THE EVOLUTION OF EARTH STRUCTURE: with a Theory of Geomorphic Changes. By T. MELLARD READE, F.G.S., F.R.I.B.A., A.M.I.C.E., etc. With 41 Plates. 8vo., 21s. net.

THORNTON.—Works by J. THORNTON, M.A.

ELEMENTARY PRACTICAL PHYSIOGRAPHY.

Part I. With 215 Illustrations. Crown 8vo., 2s. 6d.

Part II. With 98 Illustrations. Crown 8vo., 2s. 6d.

ELEMENTARY PHYSIOGRAPHY: an Introduction to the Study of Nature. With 13 Maps and 295 Illustrations. With Appendix on Astronomical Instruments and Measurements. Crown 8vo., 2s. 6d.

ADVANCED PHYSIOGRAPHY. With 11 Maps and 255 Illustrations. Crown 8vo., 4s. 6d.

NATURAL HISTORY AND GENERAL SCIENCE.

BEDDARD.—THE STRUCTURE AND CLASSIFICATION OF BIRDS. By FRANK E. BEDDARD, M.A., F.R.S., Prosector and Vice-Secretary of the Zoological Society of London. With 252 Illus. 8vo., 21s. net.

FURNEAUX.—Works by WILLIAM FURNEAUX, F.R.G.S.

THE OUTDOOR WORLD; or, The Young Collector's Handbook. With 18 Plates, 16 of which are coloured, and 549 Illustrations in the Text. Crown 8vo., 6s. net.

LIFE IN PONDS AND STREAMS. With 8 Coloured Plates and 331 Illustrations in the Text. Crown 8vo., 6s. net.

BUTTERFLIES AND MOTHS (British). With 12 Coloured Plates and 241 Illustrations in the Text. Crown 8vo., 6s. net.

THE SEA SHORE. With 8 Coloured Plates and 300 Illustrations in the Text. Crown 8vo., 6s. net.

HUDSON.—BRITISH BIRDS. By W. H. HUDSON, C.M.Z.S. With 8 Coloured Plates from Original Drawings by A. THORBURN, and 8 Plates and 100 Figures by C. E. LODGE, and 3 Illustrations from Photographs. Crown 8vo., 6s. net.

MILLAIS.—THE NATURAL HISTORY OF THE BRITISH SURFACE-FEEDING DUCKS. By JOHN GUILLE MILLAIS, F.Z.S., etc. With 6 Photogravures and 66 Plates (41 in colours) from Drawings by the Author, ARCHIBALD THORBURN, and from Photographs. Royal 4to., £6 6s. net.

NANSEN.—THE NORWEGIAN NORTH POLAR EXPEDITION, 1893-1896: Scientific Results. Edited by FRIDTJOF NANSEN. Volume I. With 44 Plates and numerous Illustrations in the Text. Demy 4to., 40s. net.

Volume II. With 2 Charts and 17 Plates. Demy 4to., 30s. net.

Volume III. With 33 Plates. Demy 4to., 32s. net.

STANLEY.—A FAMILIAR HISTORY OF BIRDS. By E. STANLEY, D.D., formerly Bishop of Norwich. With 160 Illustrations. Crown 8vo., 3s. 6d.

MANUFACTURES, TECHNOLOGY, ETC.

ASHLEY.—BRITISH INDUSTRIES: A Series of General Reviews for Business Men and Students. Edited by W. J. ASHLEY, M.A., Professor of Commerce in the University of Birmingham. Crown 8vo., 5s. 6d. net.

BELL.—JACQUARD WEAVING AND DESIGNING. By F. T. BELL. With 199 Diagrams. 8vo., 12s. net.

CROSS AND BEVAN.—Works by C. F. CROSS and E. J. BEVAN.

CELLULOSE: an Outline of the Chemistry of the Structural Elements of Plants. With reference to their Natural History and Industrial Uses. (C. F. CROSS, E. J. BEVAN and C. BEADLE.) With 14 Plates. Crown 8vo., 12s. net.

RESEARCHES ON CELLULOSE, 1895-1900. Crown 8vo., 6s. net.

MANUFACTURES, TECHNOLOGY, ETC.—Continued.

MORRIS AND WILKINSON.—THE ELEMENTS OF COTTON SPINNING. By JOHN MORRIS and F. WILKINSON. With a Preface by Sir B. A. DOBSON, C.E., M.I.M.E. With 169 Diagrams and Illustrations. Crown 8vo., 7s. 6d. net.

RICHARDS.—BRICKLAYING AND BRICK-CUTTING. By H. W. RICHARDS, Examiner in Brickwork and Masonry to the City and Guilds of London Institute, Head of Building Trades Department, Northern Polytechnic Institute, London, N. With over 200 Illustrations. Med. 8vo., 3s. 6d.

TAYLOR.—COTTON WEAVING AND DESIGNING. By JOHN T. TAYLOR. With 373 Diagrams. Crown 8vo., 7s. 6d. net.

WATTS.—AN INTRODUCTORY MANUAL FOR SUGAR GROWERS. By FRANCIS WATTS, F.C.S., F.L.C. With 20 Illustrations. Crown 8vo., 6s.

HEALTH AND HYGIENE.

ASHBY.—HEALTH IN THE NURSERY. By HENRY ASHBY, M.D., F.R.C.P. With 25 Illustrations. Crown 8vo., 3s. net.

BUCKTON.—HEALTH IN THE HOUSE. By Mrs. C. M. BUCKTON. With 41 Woodcuts and Diagrams. Crown 8vo., 2s.

CORFIELD.—THE LAWS OF HEALTH. By W. H. CORFIELD, M.A., M.D. Fcp. 8vo., 1s. 6d.

FURNEAUX.—ELEMENTARY PRACTICAL HYGIENE.—Section I. By WILLIAM S. FURNEAUX. With 146 Illustrations. Cr. 8vo., 2s. 6d.

NOTTER AND FIRTH.—Works by J. L. NOTTER, M.A., M.D., and R. H. FIRTH, F.R.C.S.

HYGIENE. With 95 Illustrations. Crown 8vo., 3s. 6d.

PRACTICAL DOMESTIC HYGIENE. With 83 Illustrations. Crown 8vo., 2s. 6d.

POORE.—Works by GEORGE VIVIAN POORE, M.D.

ESSAYS ON RURAL HYGIENE. With 12 Illustrations. Crown 8vo., 6s. 6d.

THE DWELLING-HOUSE. With 36 Illustrations. Crown 8vo., 3s. 6d.

COLONIAL AND CAMP SANITATION. With 11 Illustrations. Crown 8vo., 2s. net.

THE EARTH IN RELATION TO THE PRESERVATION AND DESTRUCTION OF CONTAGIA: being the Milroy Lectures delivered at the Royal College of Physicians in 1899, together with other Papers on Sanitation. With 13 Illustrations. Crown 8vo., 5s.

WILSON.—A MANUAL OF HEALTH-SCIENCE. By ANDREW WILSON, F.R.S.E., F.L.S., etc. With 74 Illustrations. Crown 8vo., 2s. 6d.

MEDICINE AND SURGERY.

ASHBY AND WRIGHT.—THE DISEASES OF CHILDREN, MEDICAL AND SURGICAL. By HENRY ASHBY, M.D., Lond., F.R.C.P., Physician to the General Hospital for Sick Children, Manchester; and G. A. WRIGHT, B.A., M.B. Oxon., F.R.C.S., Eng., Assistant-Surgeon to the Manchester Royal Infirmary, and Surgeon to the Children's Hospital. Enlarged and Improved Edition. With 192 Illustrations. 8vo., 25s.

BENNETT.—Works by SIR WILLIAM BENNETT, K.C.V.O., F.R.C.S., Surgeon to St. George's Hospital; Member of the Board of Examiners, Royal College of Surgeons of England.

CLINICAL LECTURES ON VARICOSE VEINS OF THE LOWER EXTREMITIES. With 3 Plates. 8vo., 6s.

ON VARICOCELE; A PRACTICAL TREATISE. With 4 Tables and a Diagram. 8vo., 5s.

CLINICAL LECTURES ON ABDOMINAL HERNIA: chiefly in relation to Treatment, including the Radical Cure. With 12 Diagrams in the Text. 8vo., 8s. 6d.

ON VARIX, ITS CAUSES AND TREATMENT, WITH ESPECIAL REFERENCE TO THROMBOSIS. 8vo., 3s. 6d.

THE PRESENT POSITION OF THE TREATMENT OF SIMPLE FRACTURES OF THE LIMBS. 8vo., 2s. 6d.

LECTURES ON THE USE OF MASSAGE AND EARLY PASSIVE MOVEMENTS IN RECENT FRACTURES AND OTHER COMMON SURGICAL INJURIES; The Treatment of Internal Derangements of the Knee Joint and Management of Stiff Joints. With 17 Illustrations. 8vo., 6s.

BENTLEY.—A TEXT-BOOK OF ORGANIC MATERIA MEDICA. Comprising a Description of the Vegetable and Animal Drugs of the British Pharmacopœia, with some others in common use. Arranged Systematically, and Especially Designed for Students. By ROBERT BENTLEY, M.R.C.S. Eng., F.L.S. With 62 Illustrations on Wood. Crown 8vo., 7s. 6d.

CABOT.—A GUIDE TO THE CLINICAL EXAMINATION OF THE BLOOD FOR DIAGNOSTIC PURPOSES. By RICHARD C. CABOT, M.D., Physician to Out-patients, Massachusetts General Hospital. With 3 Coloured Plates and 28 Illustrations in the Text. 8vo., 16s.

CARR, PICK, DORAN, AND DUNCAN.—THE PRACTITIONER'S GUIDE. By J. WALTER CARR, M.D. (Lond.), F.R.C.P.; T. PICKERING PICK, F.R.C.S.; ALBAN H. G. DORAN, F.R.C.S.; ANDREW DUNCAN, M.D., B.Sc. (Lond.), F.R.C.S., M.R.C.P. 8vo., 21s. net.

CELLI.—MALARIA, ACCORDING TO THE NEW RESEARCHES. By Prof. ANGELO CELLI, Director of the Institute of Hygiene, University of Rome. Translated from the Second Italian Edition by JOHN JOSEPH EYRE, M.R.C.P., L.R.C.S. Ireland, D.P.H. Cambridge. With an Introduction by Dr. PATRICK MANSON, Medical Adviser to the Colonial Office. 8vo., 10s. 6a.

MEDICINE AND SURGERY—Continued.

CHEYNE AND BURGHARD.—A MANUAL OF SURGICAL TREATMENT. By W. WATSON CHEYNE, C.B. M.B., F.R.C.S., F.R.S., Professor of Clinical Surgery in King's College, London, Surgeon to King's College Hospital, etc.; and F. F. BURGHARD, M.D. and M.S. (Lond.), F.R.C.S., Teacher of Practical Surgery in King's College, London, Surgeon to King's College Hospital (Lond.), etc.

Part I. The Treatment of General Surgical Diseases, including Inflammation, Suppuration, Ulceration, Gangrene, Wounds and their Complications, Infective Diseases and Tumours; the Administration of Anæsthetics. With 66 Illustrations. Royal 8vo., 10s. 6d.

Part II. The Treatment of the Surgical Affections of the Tissues, including the Skin and Subcutaneous Tissues, the Nails, the Lymphatic Vessels and Glands, the Fasciæ, Bursæ, Muscles, Tendons and Tendon-sheaths, Nerves, Arteries and Veins. Deformities. With 141 Illustrations. Royal 8vo., 14s.

Part III. The Treatment of the Surgical Affections of the Bones. Amputations. With 100 Illustrations. Royal 8vo., 12s.

Part IV. The Treatment of the Surgical Affections of the Joints (including Excisions) and the Spine. With 138 Illustrations. Royal 8vo., 14s.

Part V. The Treatment of the Surgical Affections of the Head, Face, Jaws, Lips, Larynx and Trachea; and the Intrinsic Diseases of the Nose, Ear and Larynx, by H. LAMBERT LACK, M.D. (Lond.), F.R.C.S., Surgeon to the Hospital for Diseases of the Throat, Golden Square, and to the Throat and Ear Department, The Children's Hospital, Paddington Green. With 145 Illustrations. Royal 8vo., 18s.

Part VI. Section I. The Treatment of the Surgical Affections of the Tongue and Floor of the Mouth, the Pharynx, Neck, Oesophagus, Stomach and Intestines. With 124 Illustrations. Royal 8vo., 18s.

Section II. The Treatment of the Surgical Affections of the Rectum, Liver, Spleen, Pancreas, Throat, Breast and Genito-urinary Organs. With 113 Illustrations. Royal 8vo., 21s.

CLARKE.—POST-MORTEM EXAMINATIONS IN MEDICO-LEGAL AND ORDINARY CASES. With Special Chapters on the Legal Aspects of Post-mortems, and on Certificates of Death. By J. JACKSON CLARKE, M.B. Lond., F.R.C.S., Assistant Surgeon at the North-west London and City Orthopedic Hospitals, etc. Fcp. 8vo., 2s. 6d.

COATS.—A MANUAL OF PATHOLOGY. By JOSEPH COATS, M.D., late Professor of Pathology in the University of Glasgow. Fifth Edition. Revised throughout and Edited by LEWIS R. SUTHERLAND, M.D., Professor of Pathology, University of St. Andrews. With 729 Illustrations and 2 Coloured Plates. 8vo., 28s. net.

COOKE.—Works by THOMAS COOKE, F.R.C.S. Eng., B.A., B.Sc., M.D., Paris.

TABLETS OF ANATOMY. Being a Synopsis of Demonstrations given in the Westminster Hospital Medical School. Eleventh Edition in Three Parts, thoroughly brought up to date, and with over 700 Illustrations from all the best Sources, British and Foreign. Post 4to.

Part I. The Bones. 7s. 6d. net.

Part II. Limbs, Abdomen, Pelvis. 10s. 6d. net.

Part III. Head and Neck, Thorax, Brain. 10s. 6d. net.

MEDICINE AND SURGERY—Continued.

COOKE.—Works by THOMAS COOKE (*continued*).

APHORISMS IN APPLIED ANATOMY AND OPERATIVE SURGERY. Including 100 Typical *vivâ voce* Questions on Surface Marking, etc. Crown 8vo., 3s. 6d.

DAKIN.—A HANDBOOK OF MIDWIFERY. By WILLIAM RADFORD DAKIN, M.D., F.R.C.P., Obstetric Physician and Lecturer on Midwifery at St. George's Hospital, etc. With 394 Illustrations. Large crown 8vo., 18s.

DICKINSON.—Works by W. HOWSHIP DICKINSON, M.D. Cantab., F.R.C.P.

ON RENAL AND URINARY AFFECTIONS. With 12 Plates and 122 Woodcuts. Three Parts. 8vo., £3 4s. 6d.

THE TONGUE AS AN INDICATION OF DISEASE: being the Lumleian Lectures delivered March, 1888. 8vo., 7s. 6d.

OCCASIONAL PAPERS ON MEDICAL SUBJECTS, 1855-1896. 8vo., 12s.

MEDICINE OLD AND NEW. An Address Delivered on the Occasion of the Opening of the Winter Session, 1899-1900, at St. George's Hospital Medical School, on 2nd October, 1899. Crown 8vo., 2s. 6d.

DUCKWORTH.—THE SEQUELS OF DISEASE: being the Lumleian Lectures, 1896. By Sir DYCE DUCKWORTH, M.D., LL.D., Fellow and Treasurer of the Royal College of Physicians, etc. 8vo., 10s. 6d.

ERICHSEN.—THE SCIENCE AND ART OF SURGERY; a Treatise on Surgical Injuries, Diseases, and Operations. By Sir JOHN ERICHSEN, Bart., F.R.S., LL.D. Edin., Hon. M.Ch. and F.R.C.S. Ireland. Illustrated by nearly 1000 Engravings on Wood. 2 vols. Royal 8vo., 48s.

FOWLER AND GODLEE.—THE DISEASES OF THE LUNGS. By JAMES KINGSTON FOWLER, M.A., M.D., F.R.C.P., Physician to the Middlesex Hospital and to the Hospital for Consumption and Diseases of the Chest, Brompton, etc.; and RICKMAN JOHN GODLEE, Honorary Surgeon in Ordinary to His Majesty, M.S., F.R.C.S., Fellow and Professor of Clinical Surgery, University College, London, etc. With 160 Illustrations. 8vo., 25s.

GARROD.—Works by SIR ALFRED BARING GARROD, M.D., F.R.S., etc.

A TREATISE ON GOUT AND RHEUMATIC GOUT (RHEUMATOID ARTHRITIS). With 6 Plates, comprising 21 Figures (14 Coloured), and 27 Illustrations engraved on Wood. 8vo., 21s.

THE ESSENTIALS OF MATERIA MEDICA AND THERAPEUTICS. Crown 8vo., 12s. 6d.

MEDICINE AND SURGERY—Continued.

GOADBY.—THE MYCOLOGY OF THE MOUTH : a Text-Book of Oral Bacteria. By KENNETH W. GOADBY, L.D.S. (Eng.), D.P.H. (Camb.), L.R.C.P., M.R.C.S., Bacteriologist and Lecturer on Bacteriology, National Dental Hospital, etc. With 82 Illustrations. 8vo., 8s. 6d. net.

GOODSALL AND MILES.—DISEASES OF THE ANUS AND RECTUM. By D. H. GOODSALL, F.R.C.S., Senior Surgeon, Metropolitan Hospital; Senior Surgeon, St. Mark's Hospital; and W. ERNEST MILES, F.R.C.S., Assistant Surgeon to the Cancer Hospital, Surgeon (out-patients), to the Gordon Hospital, etc. (In Two Parts.) Part I. With 91 Illustrations. 8vo., 7s. 6d. net.

GRAY.—ANATOMY, DESCRIPTIVE AND SURGICAL. By HENRY GRAY, F.R.S., late Lecturer on Anatomy at St. George's Hospital Medical School. The Fifteenth Edition Enlarged, edited by T. PICKERING PICK, F.R.C.S., Consulting Surgeon to St. George's Hospital, etc., and by ROBERT HOWDEN, M.A., M.B., C.M., Professor of Anatomy in the University of Durham, etc. With 772 Illustrations, a large proportion of which are Coloured, the Arteries being coloured red, the Veins blue, and the Nerves yellow. The attachments of the muscles to the bones, in the section on Osteology, are also shown in coloured outline. Royal 8vo., 32s. net.

HALLIBURTON.—Works by W. D. HALLIBURTON, M.D., F.R.S., Professor of Physiology in King's College, London.

A TEXT-BOOK OF CHEMICAL PHYSIOLOGY AND PATHOLOGY. With 104 Illustrations. 8vo., 28s.

ESSENTIALS OF CHEMICAL PHYSIOLOGY. With 77 Illustrations. 8vo., 5s.

HILLIER.—THE PREVENTION OF CONSUMPTION. By ALFRED HILLIER, B.A., M.D., Secretary to the National Association for the Prevention of Consumption (England), Visiting Physician to the London Open-Air Sanatorium. Revised by Professor R. KOCH. With 14 Illustrations. Crown 8vo., 5s. net.

LANG.—THE METHODOICAL EXAMINATION OF THE EYE. Being Part I. of a Guide to the Practice of Ophthalmology for Students and Practitioners. By WILLIAM LANG, F.R.C.S. Eng., Surgeon to the Royal London Ophthalmic Hospital, Moorfields, etc. With 15 Illustrations. Crown 8vo., 3s. 6d.

LUFF.—TEXT-BOOK OF FORENSIC MEDICINE AND TOXICOLOGY. By ARTHUR P. LUFF, M.D., B.Sc. (Lond.), Physician in Charge of Out-Patients and Lecturer on Medical Jurisprudence and Toxicology in St. Mary's Hospital. With 13 full-page Plates (1 in colours) and 33 Illustrations in the Text. 2 vols. Crown 8vo., 24s.

LIVERPOOL UNIVERSITY PRESS PUBLICATIONS, THE.

The Thomson Yates Laboratories Reports. Physiology; Pathology; Bacteriology; Tropical Medicine; Hygiene. Edited by RUPERT BOYCE and C. S. SHERRINGTON. With Plates and Illustrations in the text. Demy 4to. Vol. I., 1898-9, 20s. 6d.; Vol. II., 1898-9, 25s.; Vol. III., Part I., 1900, 7s. 6d.; Vol. III., Part II., 1901, 12s. 6d.; Vol. IV., Part I., 1901, 20s.; Vol. IV., Part II., 1902, 21s.; Vol. V. (New Series), Part I., Limp, 20s., Cloth, 21s.

MEDICINE AND SURGERY—Continued.

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE MEMOIRS.

With Plates and Illustrations in the text. Demy 4to.

- I. Malarial Fever: Its Cause, Prevention and Treatment. Containing full details for the use of Travellers, Sportsmen, Soldiers, and Residents in Malarious Places. By RONALD ROSS, C.B., F.R.S., F.R.C.S. With Frontispiece. 8vo., 2s. 6d.
- II. Report of the Malaria Expedition to West Africa, August, 1899. By RONALD ROSS, C.B., F.R.S., F.R.C.S., H. E. ANNETT, M.D., D.P.H. and E. E. AUSTEN. With Supplementary Reports by Major G. M. GILES, M.B. and R. FIELDING-OULD, M.B. 21s.
- III. Report of the Malaria Expedition to Nigeria. Part I. Malarial Fever, etc. By H. E. ANNETT, M.D., J. EVERETT DUTTON, M.B. and J. H. ELLIOTT, M.D. 10s. 6d.
- V. Part I. First Progress Report of the Campaign against Mosquitoes in Sierra Leone (1901). By RONALD ROSS, C.B., F.R.C.S., F.R.S. 8vo., 1s.
- V. Part II. Second Progress Report of the Campaign against Mosquitoes in Sierra Leone. By M. LOGAN TAYLOR, M.B. 8vo., 1s.
- VII. Report of the Yellow Fever Expedition to Pará (1900). By H. E. DURHAM, M.B., F.R.C.S., and the late WALTER MYERS, M.B. 4to., 7s. 6d.
- VIII. Report on the Sanitary Conditions of Cape Coast Town, with Suggestions as to Improvement of same. By M. LOGAN TAYLOR, M.B. 8vo., sewed, 1s.
- IX. Report on Malaria at Ismailia and Suez. By RONALD ROSS, C.B., F.R.C.S. 8vo., sewed, 1s.
- X. Report of the Malaria Expedition to the Gambia, 1902. By J. EVERETT DUTTON, M.B., B.Ch. Vict., and an Appendix by F. V. THEOBALD, M.A. Demy 4to., 10s. 6d. net.
- XI. First Report of the Trypanosomiasis Expedition to Senegambia (1902) of the Liverpool School of Tropical Medicine and Medical Parasitology. By J. EVERETT DUTTON, M.B., B.Ch. Vict., Walter Myers Fellow, The University, Liverpool, and JOHN L. TODD, B.A., M.D., C.M. With Notes by H. E. ANNETT, M.D., D.P.H., and an Appendix by F. V. THEOBALD, M.A. 4to., 10s. 6d. net.

MISCELLANEOUS.

Notes on Sanitary Conditions obtaining in Pará. By the MEMBERS OF THE YELLOW FEVER EXPEDITION. 8vo., 1s.

PAGET.—Edited by STEPHEN PAGET.

SELECTED ESSAYS AND ADDRESSES. By Sir JAMES PAGET. 8vo., 12s. 6d. net

MEMOIRS AND LETTERS OF SIR JAMES PAGET, BART., F.R.S., D.C.L., late Sergeant-Surgeon to Her Majesty Queen Victoria. With Portrait. 8vo., 6s. net.

PICK.—**SURGERY:** a Treatise for Students and Practitioners.

By T. PICKERING PICK, Consulting Surgeon to St. George's Hospital; Senior Surgeon to the Victoria Hospital for Children; H.M. Inspector of Anatomy in England and Wales. With 441 Illustrations. Medium 8vo., 25s.

POOLE.—**COOKERY FOR THE DIABETIC.** By W. H. and Mrs. POOLE. With Preface by Dr. PAVY. Fcap. 8vo., 2s. 6d.

MEDICINE AND SURGERY—Continued.

PROBYN-WILLIAMS.—A PRACTICAL GUIDE TO THE ADMINISTRATION OF ANÆSTHETICS. By R. J. PROBYN-WILLIAMS, M.D., Anæsthetist and Instructor in Anæsthetics at the London Hospital; Lecturer in Anæsthetics at the London Hospital Medical College, etc. With 34 Illustrations. Crown 8vo., 4s. 6d. net.

QUAIN.—QUAIN'S (SIR RICHARD) DICTIONARY OF MEDICINE. By Various Writers. Third Edition. Edited by H. MONTAGUE MURRAY, M.D., F.R.C.P., Joint Lecturer on Medicine, Charing Cross Medical School, and Physician, Charing Cross Hospital; assisted by JOHN HAROLD, M.B., B.Ch., B.A.O., Physician to St. John's and St. Elizabeth's Hospital; and W. CECIL BOSANQUET, M.A., M.D., M.R.C.P., Physician to Out-Patients, Victoria Hospital for Children, Chelsea. With 21 Plates (14 in Colour) and numerous Illustrations in the Text. 8vo., 21s. net, buckram; or 30s. net, half-morocco.

QUAIN.—QUAIN'S (JONES) ELEMENTS OF ANATOMY. The Tenth Edition. Edited by EDWARD ALBERT SCHÄFER, F.R.S., Professor of Physiology in the University of Edinburgh; and GEORGE DANCER THANE, Professor of Anatomy in University College, London.

VOL. I., PART I. EMBRYOLOGY. By E. A. SCHÄFER, F.R.S. With 200 Illustrations. Royal 8vo., 9s.

VOL. I., PART II. GENERAL ANATOMY OR HISTOLOGY. By E. A. SCHÄFER, F.R.S. With 291 Illustrations. Royal 8vo., 12s. 6d.

VOL. II., PART I. OSTEOLOGY—ARTHROLOGY. By G. D. THANE. With 224 Illus. Royal 8vo., 11s.

VOL. II., PART II. MYOLOGY—ANGEIOLOGY. By G. D. THANE. With 199 Illustrations. Royal 8vo., 16s.

VOL. III., PART I. THE SPINAL CORD AND BRAIN. By E. A. SCHÄFER, F.R.S. With 139 Illustrations. Royal 8vo., 12s. 6d.

VOL. III., PART II. THE NERVES. By G. D. THANE. With 102 Illustrations. Royal 8vo., 9s.

VOL. III., PART III. THE ORGANS OF THE SENSES. By E. A. SCHÄFER, F.R.S. With 178 Illustrations. Royal 8vo., 9s.

VOL. III., PART IV. SPLANCHNOLOGY. By E. A. SCHÄFER, F.R.S., and JOHNSON SYMINGTON, M.D. With 337 Illustrations. Royal 8vo., 16s.

APPENDIX. SUPERFICIAL AND SURGICAL ANATOMY. By Professor G. D. THANE and Professor R. J. GODLEE, M.S. With 29 Illustrations. Royal 8vo., 6s. 6d.

SCHÄFER.—Works by E. A. SCHÄFER, F.R.S., Professor of Physiology in the University of Edinburgh.

THE ESSENTIALS OF HISTOLOGY. Descriptive and Practical. For the Use of Students. With 463 Illustrations. 8vo., 9s. net.

DIRECTIONS FOR CLASS WORK IN PRACTICAL PHYSIOLOGY: Elementary Physiology of Muscle and Nerve and of the Vascular and Nervous Systems. With 48 Diagrams and 24 pages of plain paper at end for Notes. 8vo., 3s. net.

SMALE AND COLYER.—DISEASES AND INJURIES OF THE TEETH, including Pathology and Treatment. By MORTON SMALE, M.R.C.S., L.S.A., L.D.S., Dental Surgeon to St. Mary's Hospital, Dean of the School, Dental Hospital of London, etc.; and J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S., Dental Surgeon to Charing Cross Hospital and to the Dental Hospital of London. Second Edition Revised and Enlarged by J. F. COLYER. With 640 Illustrations. Large crown 8vo., 21s. net.

MEDICINE AND SURGERY—Continued.

SMITH (H. F.).—THE HANDBOOK FOR MIDWIVES. By HENRY FLY SMITH, B.A., M.B. Oxon., M.R.C.S. 41 Woodcuts. Cr. 8vo., 5s.

STEPHENS AND CHRISTOPHERS.—THE PRACTICAL STUDY OF MALARIA AND OTHER BLOOD PARASITES, including Simple Technique for Malaria and Mosquito Work, The Identification of Mosquitoes; Stages of the Yellow Fever Parasite in Stegomyia; Blackwater Fever; Chemistry of the Urine, etc., etc. By J. W. W. STEPHENS, M.D. Cantab., D.P.H., Walter Myers' Lecturer on Tropical Medicine, Liverpool University, and S. R. CHRISTOPHERS, M.B. Vict., I.M.S. Fully Illustrated. 8vo., 10s. net.

STEVENSON.—WOUNDS IN WAR: the Mechanism of their Production and their Treatment. By Surgeon-Colonel W. F. STEVENSON (Army Medical Staff), A.B., M.B., M.Ch. Dublin University, Professor of Military Surgery, Army Medical School, Netley. With 86 Illustrations. 8vo., 18s.

TAPPEINER.—INTRODUCTION TO CHEMICAL METHODS OF CLINICAL DIAGNOSIS. By Dr. H. TAPPEINER, Professor of Pharmacology and Principal of the Pharmacological Institute of the University of Munich. Translated by EDMOND J. McWEENEY, M.A., M.D. (Royal Univ. of Ireland), L.R.C.P.I., etc. Crown 8vo., 3s. 6d.

WALLER.—Works by AUGUSTUS D. WALLER, M.D., Lecturer on Physiology at St. Mary's Hospital Medical School, London; late External Examiner at the Victorian University.

AN INTRODUCTION TO HUMAN PHYSIOLOGY. Third Edition, Revised. With 314 Illustrations. 8vo., 18s.

LECTURES ON PHYSIOLOGY. First Series. On Animal Electricity. 8vo., 5s. net.

VETERINARY MEDICINE, ETC.

FITZWYGRAM.—HORSES AND STABLES. By Lieut.-General Sir F. FITZWYGRAM, Bart. With 56 pages of Illustrations. 8vo., 3s. net.

STEEL.—Works by JOHN HENRY STEEL, F.R.C.V.S., F.Z.S., A.V.D., late Professor of Veterinary Science and Principal of Bombay Veterinary College.

A TREATISE ON THE DISEASES OF THE DOG; being a Manual of Canine Pathology. Especially adapted for the use of Veterinary Practitioners and Students. With 88 Illustrations. 8vo., 10s. 6d.

A TREATISE ON THE DISEASES OF THE OX; being a Manual of Bovine Pathology. Especially adapted for the use of Veterinary Practitioners and Students. With 2 Plates and 117 Woodcuts. 8vo., 15s.

A TREATISE ON THE DISEASES OF THE SHEEP; being a Manual of Ovine Pathology for the use of Veterinary Practitioners and Students. With Coloured Plate and 99 Woodcuts. 8vo., 12s.

YOUATT.—Works by WILLIAM YOUATT.

THE HORSE. With 52 Wood Engravings. 8vo., 7s. 6d.

THE DOG. With 33 Wood Engravings. 8vo., 6s.

PHYSIOLOGY, BIOLOGY, ZOOLOGY, ETC.(And see *MEDICINE AND SURGERY*, page 25.)

- ANNANDALE AND ROBINSON.**—FASCICULI MALAY-ENSES: Anthropological and Zoological Results of an Expedition to Perak and the Siamese Malay States, 1901-2. Undertaken by NELSON ANNANDALE and HERBERT C. ROBINSON, under the auspices of the University of Edinburgh and University College, Liverpool.
- ANTHROPOLOGY.** Part I. With 17 Plates and 15 Illustrations in the text. 4to., 15s. net.
- ZOOLOGY.** Part I. With 16 Plates. 4to., 30s. net.
- ASHBY.**—NOTES ON PHYSIOLOGY FOR THE USE OF STUDENTS PREPARING FOR EXAMINATION. By HENRY ASHBY, M.D. Lond., F.R.C.P., Physician to the General Hospital for Sick Children, Manchester. With 148 Illustrations. 18mo., 5s.
- BARNETT.**—THE MAKING OF THE BODY: a Children's Book on Anatomy and Physiology. By Mrs. S. A. BARNETT. With 113 Illustrations. Crown 8vo., 1s. 9d.
- BEDDARD.**—Works by FRANK E. BEDDARD, M.A. Oxon.
- ELEMENTARY PRACTICAL ZOOLOGY.** With 93 Illustrations. Crown 8vo., 2s. 6d.
- THE STRUCTURE AND CLASSIFICATION OF BIRDS.** With 252 Illustrations. 8vo., 21s. net.
- BIDGOOD.**—A COURSE OF PRACTICAL ELEMENTARY BIOLOGY. By JOHN BIDGOOD, B.Sc., F.L.S. With 226 Illustrations. Crown 8vo., 4s. 6d.
- BOSE.**—RESPONSE IN THE LIVING AND NON-LIVING. By JAGADIS CHUNDER BOSE, M.A. (Cantab.), D.Sc. (Lond.), Professor, Presidency College, Calcutta. With 117 Illustrations. 8vo., 10s. 6d.
- BRODIE.**—THE ESSENTIALS OF EXPERIMENTAL PHYSIOLOGY. For the Use of Students. By T. G. BRODIE, M.D., Lecturer on Physiology, St. Thomas's Hospital Medical School. With 2 Plates and 177 Illustrations in the Text. 8vo., 6s. 6d.
- CHAPMAN.**—THE FORAMINIFERA: An Introduction to the Study of the Protozoa. By FREDERICK CHAPMAN, A.L.S., F.R.M.S. With 14 Plates and 42 Illustrations in the Text. 8vo., 9s. net.
- FURNEAUX.**—HUMAN PHYSIOLOGY. By W. FURNEAUX, F.R.G.S. With 218 Illustrations. Crown 8vo., 2s. 6d.
- HUDSON AND GOSSE.**—THE ROTIFERA, or 'WHEEL-ANIMACULES'. By C. T. HUDSON, LL.D., and P. H. GOSSE, F.R.S. With 30 Coloured and 4 Uncoloured Plates. In 6 Parts. 4to., 10s. 6d. each. Supplement 12s. 6d. Complete in 2 vols., with Supplement, 4to., £4 4s.
- MACALISTER.**—Works by ALEXANDER MACALISTER, M.D.
- AN INTRODUCTION TO THE SYSTEMATIC ZOOLOGY AND MORPHOLOGY OF VERTEBRATE ANIMALS.** With 41 Diagrams. 8vo., 10s. 6d.
- ZOOLOGY OF THE INVERTEBRATE ANIMALS.** With 77 Diagrams. Fcp. 8vo., 1s. 6d.
- ZOOLOGY OF THE VERTEBRATE ANIMALS.** With 59 Diagrams. Fcp. 8vo., 1s. 6d.

PHYSIOLOGY, BIOLOGY, ZOOLOGY, ETC.—Continued.

MACDOUGAL.—Works by DANIEL TREMBLY MACDOUGAL, Ph.D., Director of the Laboratories of the New York Botanical Garden.

PRACTICAL TEXT-BOOK OF PLANT PHYSIOLOGY.

With 159 Illustrations. 8vo., 7s. 6d. net.

ELEMENTARY PLANT PHYSIOLOGY. With 108 Illustrations. Crown 8vo., 3s.

MOORE.—ELEMENTARY PHYSIOLOGY. By BENJAMIN MOORE, M.A., Lecturer on Physiology at the Charing Cross Hospital Medical School. With 125 Illustrations. Crown 8vo., 3s. 6d.

MORGAN.—ANIMAL BIOLOGY: an Elementary Text-Book. By C. LLOYD MORGAN, F.R.S., Principal of University College, Bristol. With 103 Illustrations. Crown 8vo., 8s. 6d.

SCHÄFER.—DIRECTIONS FOR CLASS WORK IN PRACTICAL PHYSIOLOGY: Elementary Physiology of Muscle and Nerve and of the Vascular and Nervous Systems. By E. A. SCHÄFER, LL.D., F.R.S., Professor of Physiology in the University of Edinburgh. With 48 Diagrams. 8vo., 3s. net.

THORNTON.—Works by JOHN THORNTON, M.A.

HUMAN PHYSIOLOGY. With 284 Illustrations, some Coloured. Crown 8vo., 6s.

ELEMENTARY BIOLOGY, Descriptive and Experimental. With numerous Illustrations. Crown 8vo., 3s. 6d.

BACTERIOLOGY.

CURTIS.—THE ESSENTIALS OF PRACTICAL BACTERIOLOGY: An Elementary Laboratory Book for Students and Practitioners. By H. J. CURTIS, B.S. and M.D. (Lond.), F.R.C.S. With 133 Illustrations. 8vo., 9s.

DHINGRA.—ELEMENTARY BACTERIOLOGY. By M. L. DHINGRA, M.D., C.M. Edin., Diplomate in State Medicine, University of Cambridge, etc. With Coloured Frontispiece and 26 Illustrations in the Text. Crown 8vo., 3s. net.

FRANKLAND.—MICRO-ORGANISMS IN WATER. Together with an Account of the Bacteriological Methods involved in their Investigation. Specially designed for the use of those connected with the Sanitary Aspects of Water-Supply. By PERCY FRANKLAND, Ph.D., B.Sc. (Lond.), F.R.S., and Mrs. PERCY FRANKLAND. With 2 Plates and Numerous Diagrams. 8vo., 16s. net.

FRANKLAND.—BACTERIA IN DAILY LIFE. By Mrs. PERCY FRANKLAND, F.R.M.S. Crown 8vo., 5s. net.

GOADBY.—THE MYCOLOGY OF THE MOUTH: A Text-Book of Oral Bacteria. By KENNETH W. GOADBY, L.D.S. Eng., etc.; Bacteriologist and Lecturer on Bacteriology, National Dental Hospital, etc. With 82 Illustrations. 8vo., 8s. 6d. net.

KLÖCKER.—FERMENTATION ORGANISMS: a Laboratory Handbook. By ALB. KLÖCKER, Translated by G. E. ALLAN, B.Sc., Lecturer in the University of Birmingham, and J. H. MILLAR, F.I.C., formerly Lecturer in the British School of Malting and Brewing, and Revised by the Author. With 146 Illustrations. 8vo., 12s. net.

BACTERIOLOGY—Continued.

PLIMMER.—THE CHEMICAL CHANGES AND PRODUCTS RESULTING FROM FERMENTATION. By R. H. ANDERSON PLIMMER, D.Sc., Lond., Grocers' Research Student, Jenner Institute of Preventive Medicine. 8vo., 6s. net.

BOTANY.

AITKEN.—ELEMENTARY TEXT-BOOK OF BOTANY. By EDITH AITKEN, late Scholar of Girton College. With 400 Diagrams. Crown 8vo., 4s. 6d.

BENNETT AND MURRAY.—HANDBOOK OF CRYPTOGAMIC BOTANY. By ALFRED W. BENNETT, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas's Hospital; and GEORGE MURRAY, F.L.S., Keeper of Botany, British Museum. With 378 Illustrations. 8vo., 16s.

CROSS AND BEVAN.—Works by C. F. CROSS, E. J. BEVAN and C. BEADLE.

CELLULOSE: an Outline of the Chemistry of the Structural Elements of Plants. With Reference to their Natural History and Industrial Uses. With 14 Plates. Crown 8vo., 12s. net.

RESEARCHES ON CELLULOSE, 1895-1900. Cr. 8vo., 6s. net.

EDMONDS.—Works by HENRY EDMONDS, B.Sc., London.
ELEMENTARY BOTANY. With 342 Illustrations. Cr. 8vo., 2s. 6d.
BOTANY FOR BEGINNERS. With 85 Illustrations. Fcp. 8vo., 1s. 6d.

FARMER.—A PRACTICAL INTRODUCTION TO THE STUDY OF BOTANY: Flowering Plants. By J. BRETLAND FARMER, F.R.S., M.A., Professor of Botany in the Royal College of Science, London. With 121 Illustrations. Crown 8vo., 2s. 6d.

HOFFMANN.—ALPINE FLORA: for Tourists and Amateur Botanists. By Dr. JULIUS HOFFMANN. Translated by E. S. BARTON (Mrs. A. GEPP). With 40 Plates, containing 250 Coloured Figures, from Water-Colour Sketches by HERMANN FRIESE. With Text descriptive of the most widely distributed and attractive of Alpine Plants. 8vo., 7s. 6d. net.

KITCHENER.—A YEAR'S BOTANY. Adapted to Home and School Use. By FRANCES A. KITCHENER. With 105 Illustrations. Cr. 8vo., 5s.

LINDLEY AND MOORE.—THE TREASURY OF BOTANY. Edited by J. LINDLEY, M.D., F.R.S., and T. MOORE, F.L.S. With 20 Steel Plates and numerous Woodcuts. Two parts. Fcp. 8vo., 12s.

McNAB.—CLASS-BOOK OF BOTANY. By W. R. McNAB.
MORPHOLOGY AND PHYSIOLOGY. With 42 Diagrams. Fcp. 8vo., 1s. 6d.
CLASSIFICATION OF PLANTS. With 118 Diagrams. Fcp. 8vo., 1s. 6d.

SORAUER.—A POPULAR TREATISE ON THE PHYSIOLOGY OF PLANTS. By Dr. PAUL SORAUER. Translated by F. E. WEISS, B.Sc., F.L.S. With 33 Illustrations. 8vo., 9s. net.

BOTANY—Continued.

THOMÉ AND BENNETT.—STRUCTURAL AND PHYSIOLOGICAL BOTANY. By OTTO WILHELM THOMÉ and by ALFRED W. BENNETT, B.Sc., F.L.S. With Coloured Map and 600 Woodcuts. Fcp. 8vo., 6s.

TUBEUF.—DISEASES OF PLANTS INDUCED BY CRYPTOGAMIC PARASITES. Introduction to the Study of Pathogenic Fungi, Slime Fungi, Bacteria and Algae. By Dr. KARL FREIHERR VON TUBEUF, Privatdocent in the University of Munich. English Edition by WILLIAM G. SMITH, B.Sc., Ph.D., Lecturer on Plant Physiology, University of Edinburgh. With 330 Illustrations. Royal 8vo., 18s. net.

WATTS.—A SCHOOL FLORA. For the use of Elementary Botanical Classes. By W. MARSHALL WATTS, D.Sc. Lond. Cr. 8vo., 2s. 6d.

AGRICULTURE AND GARDENING.

ADDYMAN.—AGRICULTURAL ANALYSIS. A Manual of Quantitative Analysis for Students of Agriculture. By FRANK T. ADDYMAN, B.Sc. (Lond.), F.I.C. With 49 Illustrations. Crown 8vo., 5s. net.

COLEMAN AND ADDYMAN.—PRACTICAL AGRICULTURAL CHEMISTRY. By J. BERNARD COLEMAN, A.R.C.Sc., F.I.C., and FRANK T. ADDYMAN, B.Sc. (Lond.), F.I.C. With 24 Illustrations. Crown 8vo., 1s. 6d. net.

HAGGARD.—Works by H. RIDER HAGGARD.

A FARMER'S YEAR: being his Commonplace Book for 1898. With 36 Illustrations by G. LEON LITTLE and three others. Crown 8vo., 7s. 6d. net.

RURAL ENGLAND: being an Account of Agricultural and Social Researches carried out in the years 1901 and 1902. With 23 Agricultural Maps and 75 Illustrations from Photographs. 2 vols. 8vo., 36s. net.

JEKYLL.—Works by GERTRUDE JEKYLL.

HOME AND GARDEN: Notes and Thoughts, Practical and Critical, of a Worker in both. With 53 Illustrations from Photographs. 8vo., 10s. 6d. net.

WOOD AND GARDEN: Notes and Thoughts, Practical and Critical, of a Working Amateur. With 71 Photographs. 8vo., 10s. 6d. net.

WEATHERS.—A PRACTICAL GUIDE TO GARDEN PLANTS. Containing Descriptions of the Hardest and most Beautiful Annuals and Biennials, Hardy Herbaceous and Bulbous Perennials, Hardy Water and Bog Plants, Flowering and Ornamental Trees and Shrubs, Conifers, Hardy Ferns, Hardy Bamboos and other Ornamental Grasses; and also the best kinds of Fruit and Vegetables that may be grown in the Open Air in the British Islands, with Full and Practical Instructions as to Culture and Propagation. By JOHN WEATHERS, F.R.H.S., late Assistant Secretary to the Royal Horticultural Society, formerly of the Royal Gardens, Kew, etc. With 163 Diagrams. 8vo., 21s. net.

WEBB.—Works by HENRY J. WEBB, Ph.D., B.Sc. (Lond.).

ELEMENTARY AGRICULTURE. A Text-Book specially adapted to the requirements of the Board of Education, the Junior Examination of the Royal Agricultural Society, and other Elementary Examinations. With 34 Illustrations. Crown 8vo., 2s. 6d.

AGRICULTURE. A Manual for Advanced Science Students. With 100 Illustrations. Crown 8vo., 7s. 6d. net.

WORKS BY JOHN TYNDALL, D.C.L., LL.D., F.R.S.

LECTURES ON SOUND. With Frontispiece of Fog-Syren, and 203 other Woodcuts and Diagrams in the Text. Crown 8vo., 10s. 6d.

HEAT, A MODE OF MOTION. With 125 Woodcuts and Diagrams. Crown 8vo., 12s.

LECTURES ON LIGHT DELIVERED IN THE UNITED STATES IN 1872 AND 1873. With Portrait, Lithographic Plate, and 59 Diagrams. Crown 8vo., 5s.

FRAGMENTS OF SCIENCE: a Series of Detached Essays, Addresses, and Reviews. 2 vols. Crown 8vo., 16s.

Vol. I.—The Constitution of Nature—Radiation—On Radiant Heat in Relation to the Colour and Chemical Constitution of Bodies—New Chemical Reactions produced by Light—On Dust and Disease—Voyage to Algeria to observe the Eclipse—Niagara—The Parallel Roads of Glen Roy—Alpine Sculpture—Recent Experiments on Fog-Signals—On the Study of Physics—On Crystalline and Slaty Cleavage—On Paramagnetic and Diamagnetic Forces—Physical Basis of Solar Chemistry—Elementary Magnetism—On Force—Contributions to Molecular Physics—Life and Letters of FARADAY—The Copley Medallist of 1870—The Copley Medallist of 1871—Death by Lightning—Science and the Spirits.

Vol. II.—Reflections on Prayer and Natural Law—Miracles and Special Providences—On Prayer as a Form of Physical Energy—Vitality—Matter and Force—Scientific Materialism—An Address to Students—Scientific Use of the Imagination—The Belfast Address—Apology for the Belfast Address—The Rev. JAMES MARTINEAU and the Belfast Address—Fermentation, and its Bearings on Surgery and Medicine—Spontaneous Generation—Science and Man—Professor VIRCHOW and Evolution—The Electric Light.

NEW FRAGMENTS. Crown 8vo., 10s. 6d.

CONTENTS.—The Sabbath—Goethe's 'Farbenlehre'—Atoms, Molecules, and Ether Waves—Count Rumford—Louis Pasteur, his Life and Labours—The Rainbow and its Congeners—Address delivered at the Birkbeck Institution on October 22, 1884—Thomas Young—Life in the Alps—About Common Water—Personal Recollections of Thomas Carlyle—On Unveiling the Statue of Thomas Carlyle—On the Origin, Propagation, and Prevention of Phthisis—Old Alpine Jottings—A Morning on Alp Lusen.

ESSAYS ON THE FLOATING MATTER OF THE AIR IN RELATION TO PUTREFACTION AND INFECTION. With 24 Woodcuts. Crown 8vo., 7s. 6d.

RESEARCHES ON DIAMAGNETISM AND MAGNECRYSTALLIC ACTION; including the Question of Diamagnetic Polarity. Crown 8vo., 12s.

NOTES OF A COURSE OF NINE LECTURES ON LIGHT, delivered at the Royal Institution of Great Britain, 1869. Crown 8vo., 1s. 6d.

NOTES OF A COURSE OF SEVEN LECTURES ON ELECTRICAL PHENOMENA AND THEORIES, delivered at the Royal Institution of Great Britain, 1870. Crown 8vo., 1s. 6d.

LESSONS IN ELECTRICITY AT THE ROYAL INSTITUTION 1875-1876. With 58 Woodcuts and Diagrams. Crown 8vo., 2s. 6d.

THE GLACIERS OF THE ALPS: being a Narrative of Excursions and Ascents. An Account of the Origin and Phenomena of Glaciers, and an Exposition of the Physical Principles to which they are related. With 7 Illustrations. Crown 8vo., 6s. 6d. net.

HOURS OF EXERCISE IN THE ALPS. With 7 Illustrations. Crown 8vo., 6s. 6d. net.

FARADAY AS A DISCOVERER. Crown 8vo., 3s. 6d.

TEXT-BOOKS OF SCIENCE.

- PHOTOGRAPHY. By Sir WILLIAM DE WIVELESIE ABNEY, K.C.B., F.R.S. With 134 Illustrations. Fcp. 8vo., 5s.
- THE STRENGTH OF MATERIALS AND STRUCTURES. By Sir J. ANDERSON, C.E. With 66 Illustrations. Fcp. 8vo., 3s. 6d.
- RAILWAY APPLIANCES. By Sir JOHN WOLFE BARRY, K.C.B., F.R.S., M.I.C.E. With 218 Illustrations. Fcp. 8vo., 4s. 6d.
- INTRODUCTION TO THE STUDY OF INORGANIC CHEMISTRY. By WILLIAM ALLEN MILLER, M.D., LL.D., F.R.S. With 72 Illustrations. 3s. 6d.
- QUANTITATIVE CHEMICAL ANALYSIS. By T. E. THORPE, C.B., F.R.S., Ph.D. With 88 Illustrations. Fcp. 8vo., 4s. 6d.
- QUALITATIVE ANALYSIS AND LABORATORY PRACTICE. By T. E. THORPE, C.B., Ph.D., F.R.S., and M. M. PATTISON MUIR, M.A. and F.R.S.E. With Plate of Spectra and 57 Illustrations. Fcp. 8vo., 3s. 6d.
- INTRODUCTION TO THE STUDY OF CHEMICAL PHILOSOPHY. By WILLIAM A. TILDEN, D.Sc., London, F.R.S. With Illustrations. Fcp. 8vo., 5s. With Answers to Problems. Fcp. 8vo., 5s. 6d.
- ELEMENTS OF ASTRONOMY. By Sir R. S. BALL, LL.D., F.R.S. With 130 Illustrations. Fcp. 8vo., 6s. 6d.
- SYSTEMATIC MINERALOGY. By HILARY BAUERMAN, F.G.S. With 373 Illustrations. Fcp. 8vo., 6s.
- DESCRIPTIVE MINERALOGY. By HILARY BAUERMAN, F.G.S., etc. With 236 Illustrations. Fcp. 8vo., 6s.
- METALS: THEIR PROPERTIES AND TREATMENT. By A. K. HUNTINGTON and W. G. McMILLAN. With 122 Illustrations. Fcp. 8vo., 7s. 6d.
- THEORY OF HEAT. By J. CLERK MAXWELL, M.A., LL.D., Edin., F.R.S.S., L. & E. With 38 Illustrations. Fcp. 8vo., 4s. 6d.
- PRACTICAL PHYSICS. By R. T. GLAZEBROOK, M.A., F.R.S., and W. N. SHAW, M.A. With 134 Illustrations. Fcp. 8vo., 7s. 6d.
- PRELIMINARY SURVEY AND ESTIMATES. By THEODORE GRAHAM GRIBBLE, Civil Engineer. Including Elementary Astronomy, Route Surveying, Tacheometry, Curve-ranging, Graphic Mensuration, Estimates, Hydrography and Instruments. With 133 Illustrations. Fcp. 8vo., 7s. 6d.
- ALGEBRA AND TRIGONOMETRY. By WILLIAM NATHANIEL GRIFFIN, B.D. 3s. 6d. Notes on, with Solutions of the more difficult Questions. Fcp. 8vo., 3s. 6d.
- THE STEAM ENGINE. By GEORGE C. V. HOLMES, Secretary of the Institution of Naval Architects. With 212 Illustrations. Fcp. 8vo., 6s.
- ELECTRICITY AND MAGNETISM. By FLEEMING JENKIN, F.R.S.S., L. & E. With 177 Illustrations. Fcp. 8vo., 3s. 6d.
- THE ART OF ELECTRO-METALLURGY. By G. GORE, LL.D., F.R.S. With 56 Illus. Fcp. 8vo., 6s.
- TELEGRAPHY. By Sir W. H. PREECE, K.C.B., F.R.S., M.I.C.E., and Sir J. SIVEWRIGHT, M.A., K.C.M.G. With 267 Illustrations. Fcp. 8vo., 6s.
- PHYSICAL OPTICS. By R. T. GLAZEBROOK, M.A., F.R.S. With 183 Illustrations. Fcp. 8vo., 6s.
- TECHNICAL ARITHMETIC AND MENSURATION. By CHARLES W. MERRIFIELD, F.R.S. 3s. 6d. Key, by the Rev. JOHN HUNTER, M.A. Fcp. 8vo., 3s. 6d.
- THE STUDY OF ROCKS. By FRANK RUTLEY, F.G.S. With 6 Plates and 88 Illustrations. Fcp. 8vo., 4s. 6d.
- WORKSHOP APPLIANCES, including Descriptions of some of the Machine Tools used by Engineers. By C. P. B. SHELLY, M.I.C.E. With 323 Illustrations. Fcp. 8vo., 5s.
- ELEMENTS OF MACHINE DESIGN. By W. CAWTHORNE UNWIN, F.R.S., B.Sc., M.I.C.E.
- PART I. General Principles, Fastenings and Transmissive Machinery. With 345 Illustrations. Fcp. 8vo., 7s. 6d.
- PART II. Chiefly on Engine Details. With 259 Illustrations. Fcp. 8vo., 6s.
- STRUCTURAL AND PHYSIOLOGICAL BOTANY. By OTTO WILHELM THOMÉ, and A. W. BENNETT, M.A., B.Sc., F.L.S. With 600 Illustrations. Fcp. 8vo., 6s.
- PLANE AND SOLID GEOMETRY. By H. W. WATSON, M.A. Fcp. 8vo., 3s. 6d.

ADVANCED SCIENCE MANUALS.

- BUILDING CONSTRUCTION.** By the Author of 'Rivington's Notes on Building Construction'. With 385 Illustrations and an Appendix of Examination Questions. Crown 8vo., 4s. 6d.
- THEORETICAL MECHANICS.** Solids, including Kinematics, Statics, and Kinetics. By A. THORNTON, M.A., F.R.A.S. With 220 Illustrations, 130 Worked Examples, and over 900 Examples from Examination Papers, etc. Crown 8vo., 4s. 6d.
- HEAT.** By MARK R. WRIGHT, Hon. Inter. B.Sc. (Lond.). With 136 Illustrations and numerous Examples and Examination Papers. Crown 8vo., 4s. 6d.
- LIGHT.** By W. J. A. EMTAGE, M.A. With 232 Illustrations. Cr. 8vo., 6s.
- MAGNETISM AND ELECTRICITY.** By ARTHUR WILLIAM POYSER, M.A. With 317 Illustrations. Crown 8vo., 4s. 6d.
- INORGANIC CHEMISTRY, THEORETICAL AND PRACTICAL.** By WILLIAM JAGO, F.C.S., F.I.C. With Plate of Spectra and 78 Woodcuts. Crown 8vo., 4s. 6d.
- GEOLOGY:** a Manual for Students in Advanced Classes and for General Readers. By CHARLES BIRD, B.A. (Lond.), F.G.S. With over 300 Illustrations, a Geological Map of the British Isles (coloured), and a set of Questions for Examination. Crown 8vo., 7s. 6d.
- HUMAN PHYSIOLOGY:** a Manual for Students in advanced Classes of the Science and Art Department. By JOHN THORNTON, M.A. With 284 Illustrations, some of which are Coloured, and a set of Questions for Examination. Crown 8vo., 6s.
- PHYSIOGRAPHY.** By JOHN THORNTON, M.A. With 11 Maps, 255 Illustrations, and Coloured Map of Ocean Deposits. Crown 8vo., 4s. 6d.
- AGRICULTURE.** By HENRY J. WEBB, Ph.D., B.Sc. With 100 Illustrations. Crown 8vo., 7s. 6d. net.
- HYGIENE.** By J. LANE NOTTER, M.A., M.D., Professor of Hygiene in the Army Medical School, Netley, Colonel, Royal Army Medical Corps; and R. H. FIRTH, F.R.C.S., late Assistant Professor of Hygiene in the Army Medical School, Netley, Major, Royal Army Medical Corps. With 95 Illustrations. Crown 8vo., 3s. 6d.

ELEMENTARY SCIENCE MANUALS.

- PRACTICAL, PLANE, AND SOLID GEOMETRY.** By I. H. MORRIS and JOSEPH HUSBAND. Fully Illustrated with Drawings. Crown 8vo., 2s. 6d.
- GEOMETRICAL DRAWING FOR ART STUDENTS.** Embracing Plane Geometry and its Applications, the Use of Scales, and the Plans and Elevations of Solids. By I. H. MERRIS. Crown 8vo., 2s.
- TEXT-BOOK ON PRACTICAL, SOLID, OR DESCRIPTIVE GEOMETRY.** By DAVID ALLAN LOW (Whitworth Scholar). Part I. Crown 8vo., 2s. Part II. Crown 8vo., 3s.
- AN INTRODUCTION TO MACHINE DRAWING AND DESIGN.** By DAVID ALLAN LOW. With 153 Illustrations. Crown 8vo., 2s. 6d.
- BUILDING CONSTRUCTION AND DRAWING.** By EDWARD J. BURRELL. With 308 Illustrations and Working Drawings. Crown 8vo., 2s. 6d.
- AN ELEMENTARY COURSE OF MATHEMATICS.** Containing Arithmetic; Euclid (Book I., with Deductions and Exercises); and Algebra. Crown 8vo., 2s. 6d.

ELEMENTARY SCIENCE MANUALS—Continued.

- THEORETICAL MECHANICS.** Including Hydrostatics and Pneumatics. By J. E. TAYLOR, M.A., B.Sc. With numerous Examples and Answers, and 175 Diagrams and Illustrations. Crown 8vo., 2s. 6d.
- THEORETICAL MECHANICS—SOLIDS.** By J. E. TAYLOR, M.A., B.Sc. (Lond.). With 163 Illustrations, 120 Worked Examples, and over 500 Examples from Examination Papers, etc. Crown 8vo., 2s. 6d.
- THEORETICAL MECHANICS—FLUIDS.** By J. E. TAYLOR, M.A., B.Sc. (Lond.). With 122 Illustrations, numerous Worked Examples, and about 500 Examples from Examination Papers, etc. Crown 8vo., 2s. 6d.
- A MANUAL OF MECHANICS.** With 138 Illustrations and Diagrams, and 188 Examples taken from Examination Papers, with Answers. By T. M. GOODEVE, M.A. Crown 8vo., 2s. 6d.
- SOUND, LIGHT, AND HEAT.** By MARK R. WRIGHT, M.A. With 160 Diagrams and Illustrations. Crown 8vo., 2s. 6d.
- METALLURGY: an Elementary Text-Book.** By E. L. RHEAD. With 94 Illustrations. Crown 8vo., 3s. 6d.
- PHYSICS, Alternative Course.** By MARK R. WRIGHT, M.A. With 242 Illustrations. Crown 8vo., 2s. 6d.
- MAGNETISM AND ELECTRICITY.** By A. W. POYSER, M.A. With 235 Illustrations. Crown 8vo., 2s. 6d.
- PROBLEMS AND SOLUTIONS IN ELEMENTARY ELECTRICITY AND MAGNETISM.** By W. SLINGO and A. BROOKER. Embracing a Complete Set of Answers to the South Kensington Papers for the years 1885-1899, and a Series of Original Questions. With 67 Original Illustrations. Crown 8vo., 2s.
- ELEMENTARY PHYSIOGRAPHY.** By J. THORNTON, M.A. With 13 Maps and 295 Illustrations. With Appendix on Astronomical Instruments and Measurements. Crown 8vo., 2s. 6d.
- ORGANIC CHEMISTRY: the Fatty Compounds.** By R. LLOYD WHITELEY, F.I.C., F.C.S. With 45 Illustrations. Crown 8vo., 3s. 6d.
- INORGANIC CHEMISTRY, THEORETICAL AND PRACTICAL.** By WILLIAM JAGO, F.C.S., F.I.C. With 63 Illustrations and numerous Questions and Exercises. Fcp. 8vo., 2s. 6d.
- AN INTRODUCTION TO PRACTICAL INORGANIC CHEMISTRY.** By WILLIAM JAGO, F.C.S., F.I.C. Crown 8vo., 1s. 6d.
- PRACTICAL CHEMISTRY: the Principles of Qualitative Analysis.** By WILLIAM A. TILDEN, D.Sc. Fcp. 8vo., 1s. 6d.
- ELEMENTARY INORGANIC CHEMISTRY.** By WILLIAM FURNEAUX, F.R.G.S. Crown 8vo., 2s. 6d.
- ELEMENTARY GEOLOGY.** By CHARLES BIRD, B.A., F.G.S. With Coloured Geological Map of the British Islands, and 247 Illustrations. Crown 8vo., 2s. 6d.
- HUMAN PHYSIOLOGY.** By WILLIAM FURNEAUX, F.R.G.S. With 218 Illustrations. Crown 8vo., 2s. 6d.
- A COURSE OF PRACTICAL ELEMENTARY GEOLOGY.** By J. BIDGOOD, B.Sc. With 226 Illustrations. Crown 8vo., 4s. 6d.
- ELEMENTARY BOTANY, THEORETICAL AND PRACTICAL.** By HENRY EDMONDS, B.Sc. With 342 Illustrations. Crown 8vo., 2s. 6d.
- STEAM.** By WILLIAM RIPPER, Member of the Institution of Civil Engineers. With 185 Illustrations. Crown 8vo., 2s. 6d.
- AGRICULTURE.** By HENRY J. WEBB, Ph.D. With 34 Illustrations. Crown 8vo., 2s. 6d.

THE LONDON SCIENCE CLASS-BOOKS.

Edited by G. CAREY FOSTER, F.R.S., and by Sir PHILIP MAGNUS, B.Sc., B.A.,
of the City and Guilds of London Institute.

- ASTRONOMY.** By Sir ROBERT STAWELL BALL, LL.D., F.R.S. With 41 Diagrams. Fcp. 8vo., 1s. 6d.
- MECHANICS.** By Sir ROBERT STAWELL BALL, LL.D., F.R.S. With 89 Diagrams. Fcp. 8vo., 1s. 6d.
- THE LAWS OF HEALTH.** By W. H. CORFIELD, M.A., M.D., F.R.C.P. With 22 Illustrations. Fcp. 8vo., 1s. 6d.
- MOLECULAR PHYSICS AND SOUND.** By FREDERICK GUTHRIE, F.R.S. With 91 Diagrams. Fcp. 8vo., 1s. 6d.
- GEOMETRY, CONGRUENT FIGURES.** By O. HENRICI, Ph.D., F.R.S. With 141 Diagrams. Fcp. 8vo., 1s. 6d.
- ZOOLOGY OF THE INVERTEBRATE ANIMALS.** By ALEXANDER MACALISTER, M.D. With 77 Diagrams. Fcp. 8vo., 1s. 6d.
- ZOOLOGY OF THE VERTEBRATE ANIMALS.** By ALEXANDER MACALISTER, M.D. With 59 Diagrams. Fcp. 8vo., 1s. 6d.
- HYDROSTATICS AND PNEUMATICS.** By Sir PHILIP MAGNUS, B.Sc., B.A. With 79 Diagrams. Fcp. 8vo., 1s. 6d. (To be had also with *Answers*, 2s.) The Worked Solutions of the Problems. 2s.
- BOTANY.** Outlines of the Classification of Plants. By W. R. McNAB, M.D. With 118 Diagrams. Fcp. 8vo., 1s. 6d.
- BOTANY.** Outlines of Morphology and Physiology. By W. R. McNAB, M.D. With 42 Diagrams. Fcp. 8vo., 1s. 6d.
- THERMODYNAMICS.** By RICHARD WORMELL, M.A., D.Sc. With 41 Diagrams. Fcp. 8vo., 1s. 6d.

PRACTICAL ELEMENTARY SCIENCE SERIES.

- ELEMENTARY PRACTICAL PHYSIOGRAPHY.** (Section I.) By JOHN THORNTON, M.A. With 215 Illustrations and a Coloured Spectrum. Crown 8vo., 2s. 6d.
- ELEMENTARY PRACTICAL PHYSIOGRAPHY.** (Section II.) A Course of Lessons and Experiments in Elementary Science for the King's Scholarship Examination. By JOHN THORNTON, M.A. With 98 Illustrations and a Series of Questions. Crown 8vo., 2s. 6d.
- PRACTICAL DOMESTIC HYGIENE.** Stage I. By J. LANE NOTTER, M.A., M.D., and R. H. FIRTH, F.R.C.S. With 83 Illustrations. Crown 8vo., 2s. 6d.
- A PRACTICAL INTRODUCTION TO THE STUDY OF BOTANY: Flowering Plants.** By J. BRET LAND FARMER, F.R.S., M.A. With 121 Illustrations. Crown 8vo., 2s. 6d.
- ELEMENTARY PRACTICAL HYGIENE.** Section I. By WILLIAM S. FURNEAUX. With Appendix to meet the requirements of the 1902 Syllabus of the Board of Education. With 146 Illustrations. Crown 8vo., 2s. 6d.
- ELEMENTARY PRACTICAL SOUND, LIGHT, AND HEAT.** Stage I. By JOSEPH S. DEXTER. With 152 Illustrations. Crown 8vo., 2s. 6d.
- PRACTICAL MATHEMATICS.** Stage I. By A. G. CRACKNELL, M.A., B.Sc. Crown 8vo., 3s. 6d.
- ELEMENTARY PRACTICAL CHEMISTRY.** Stage I. By G. S. NEWTH, F.I.C., F.C.S. With 108 Illustrations and 254 Experiments. Crown 8vo., 2s. 6d.
- ELEMENTARY PRACTICAL PHYSICS.** Stage I. By W. WATSON, D.Sc. With 120 Illustrations and 193 Exercises. Crown 8vo., 2s. 6d.
- ELEMENTARY BIOLOGY.** By JOHN THORNTON, M.A. With 108 Illustrations. Crown 8vo., 3s. 6d.
- THE ELEMENTS OF GEOMETRICAL DRAWING: an Elementary Text-book on Practical Plane Geometry, including an Introduction to Solid Geometry.** By HENRY J. SPOONER, C.E., M.Inst.M.E. Crown 8vo., 3s. 6d.

